PB-231 147

THE ECONOMICS OF CLEAN WATER. VOLUME III. INDUSTRY EXPENDITURES FOR WATER POLLUTION ABATEMENT

Conference Board Incorporated

Prepared for:

Environmental Protection Agency

January 1972

DISTRIBUTED BY:

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U. S. DEPARTMENT OF COMMERCE
5285 Port Royal Road, Springfield Va. 22151

PB 231 147

Industry Expenditures for Water Pollution Abatement

Conducted By

THE CONFERENCE BOARD
New York, New York

The research upon which this publication is based was performed pursuant to Contract No. 14-12-844 with the Office of Water Programs, Environmental Protection Agency, Washington, D.C.

January, 1972

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106

The following survey was undertaken to provide detailed information on the industrial view of water pollution control costs.

Besides providing information on the cost met and expected by industry, the survey will prove useful in determining existing and anticipated waste-handling relationships between industrial plants and public systems and in providing a basis for judging the rate of progress made by the industrial sector in meeting national water quality objectives.

The survey is considered a supplement to the *Economics of Clean Water* report to the Congress for 1972.

Environmental Protection Agency

Contents

Foreword iv
Summary 1
Capital Funds for Industrial Water Pollution Control 5
Size of Plant as a Factor in Pollution Abatement Expenditures 8
Expenditures for Operation and Maintenance of Pollution Abatement Facilities 14
Projected Appropriations for Pollution Abatement Facilities 19
Measures of Effort in Pollution Control 21
Wastewater Volume and Characteristics 25
Use of Public Sewer Facilities 32
Wastewater Treatment Procedures 36
Wastewater Treatment Costs 39
Plant Location as a Factor 41
The Problem of Nonresponse 45
Data Relationships with *Water Use in Manufacturing* 48

APPENDIXES

A. Survey Questionnaire 55
Tabular Sources 63
B. Capital Expenditures Cost Data 65
C. Data on Annual Expenditures for Operation and Maintenance 79
D. Public Sewer Use Data 91
E. Data on Wastewater Volume and Effluents 97

Foreword

FACED WITH THE NEED to reduce the mounting deterioration of the environment, man has organized a variety of campaigns to control those substances which cause pollution. These campaigns have been mounted by governments, by private environmental organizations, and by industry. The governing bodies, administrative and legislative at all levels, have promulgated laws, made regulations, and moved to enforce them. They have provided incentive programs, have set standards and have provided some financial assistance. The private environmental organizations have publicized, advised, and lobbied for additional laws and regulations, and have educated and aroused the public on the dangers of environmental pollution. Industry has invested capital and talent in the construction and operation of pollution control facilities and in the development of new technology to deal with these problems.

The progress in reducing the extent of water pollution can be gauged by very few indicators among which are the dollars spent for the construction and operation of pollution control facilities. Nor can the scope of the task that must be undertaken to provide for a state of relative purity of the nation's waters be determined without some estimate of the magnitude of industrial pollution.

The Environmental Protection Agency, faced with the responsibility of advising and guiding the lawmakers, administrators, and enforcers, contracted for the compilation of data on industrial water pollution abatement costs and activities.

This study was performed pursuant to Contract No. 14-12-844 with the Office of Water Programs, Environmental Protection Agency. The research staff of the Public Affairs Research Division of The Conference Board was the contracting agent. The study was under the direction of Dr. Leonard Lund with principal staff assistance by Miss Sherry Cohen. Sincere appreciation is owed Dr. William J. J. Smith for his counsel, assistance, and ideas, and to Mr. Donald McMahon, Mr. Stanley PoKempner, and Mr. Luke McSherry for advice and comment. A special acknowledgement to Mr. Michael Papantoniou, for preparation of computer data. A word of gratitude is due also the typists, Mrs. Lora Peralto, Mrs. Frances Dolan, and Mrs. Elise Higginbotham.

This is an opportunity also to acknowledge the cooperation and helpfulness of members of the Environmental Protection Agency staff, to Mr. Edwin L. Johnson, Mr. Robert Brown, Mr. Robert Coughlin, and Dr. Jon Rasmussen, now at Wesleyan University.

Summary

SERIOUS PROBLEMS of industrial water pollution are related to the manufacturing activity of a select number of industries which account for the major quantity of the nation's water use and discharge. They must also, however, be credited with extending efforts toward abatement of the pollution resulting from their manufacturing activity.

For this study, the measures which were chosen by which to gauge industrial efforts were those related to other indicators of industrial activity, namely, the expenditures made for physical abatement facilities, the expenditures made for operation of these facilities, and the numbers of employees assigned to operation of these facilities for the abatement of pollution. Other factors added to the equation were the demands placed upon the plant abatement operation in terms of the flow of wastewater and the effluent composition of this wastewater. A further dimension was inserted by a consideration of use of the principal alternative to plant abatement procedures, the public sewer and treatment systems, its extent of use, and its relative cost.

The expenditures made for capital projects and their operation were viewed against an array of standard measures of manufacturing activity to develop guideposts of relationships between the total operation of a manufacturing establishment and the pollution abatement activity in that plant. The ratios were developed in aggregate form to minimize individual differences, but attention was given to problems and characteristics of separate industry categories and specific product lines, where meaningful.

The information in this report was developed from a survey of manufacturing establishments in seven major industry categories which accounted for 92.3% of the water used and discharged in 1968 by all of the manufacturing industries included in the 1967 Census of Manufactures report, *Water Use in Manufacturing*. This major grouping was further refined according to water use and effluent problem into 51 classifications by principal product manufactured.

The data presented in the document were assembled from 789 responses to the survey questionnaire and are representative of the seven major industry categories including four of the 51 product classifications which are responsible for major quantities of wastewater discharge; paper mills, paperboard mills, organic chemicals plants, and petroleum refineries. Information on a fifth major water user, the steel industry, is subject to limitations because of inadequate response from the major steel producers.

There is noticeable variance in the response to many of the items on the questionnaire, particularly those items dealing with the volume and composition of discharged wastewaters. The respondents indicated few instances where such information had been withheld. Therefore, it may be surmised that the collection of data on the amounts of wastewater discharged and the measurement and analysis of effluents had not yet become a standard practice in many manufacturing establishments in 1969.

Capital Expenditures for Pollution Abatement Facilities

In the five-year period from 1965 to 1969, 500 of the 789 plants surveyed, 63% of the

plants, made some expenditure for the construction of pollution abatement facilities. Very little of this expenditure was a result of major overhauling of total plant productive capacity, but was for additions to existing production processes. The increase in expenditure from 1965 to 1969 was a percentage rise of 239% to a level of $112.6 million in 1969. The greatest portion of this five-year expenditure program was devoted to the construction of wastewater treatment facilities and only a small portion toward developing changes in the manufacturing process which would result in significant pollution reduction.

One of several factors which are meaningful determinants of the amount of expenditure is the size of the plant. The amount of total expenditure attributable to the smallest plant size, one employing fewer than 100 employees, was only .87% of the total annual expenditure for water pollution abatement. The very large plants, those employing more than 1,000 workers, made more than 52.7% of the total outlays.

The size of plant factor, when applied to a ratio of expenditures for operating abatement facilities to other cost factors, consistently indicates a decreasing proportion as the size of the plant increases, with a major difference between the plants employing less than 100 people and the plants employing more than 100 people. The differences that occur between the other size categories are markedly less apparent.

The expenditures made over the five-year period, 1965-1969, as a ratio of gross capital investment in plant for all industries was at a level of 2.4% for the small plants and at less than 1% for the largest establishments. Paper, chemicals, and petroleum made larger dollar expenditures and posted higher ratios of expenditure to investment than the other industries. In 1969, the mean capital expenditure for construction of abatement facilities was $306,000 per plant, with expenditures in excess of $1 million per plant evident in the paper industry, the petroleum industry, and the copper industry.

Annual Operating Expenditures for Pollution Abatement

While capital expenditures are some evidence of investment in pollution control activities, the annual cost of operating the equipment and supplying operational programs provides a continuing measure of pollution control activity. In 1969, 463 plants reported expenditures of $65,405,000 for operating pollution abatement programs. The number of employees assigned to operation purposes in reporting plants was 2,018. In most plants this function occupies little importance in terms of personnel assignments, accounting for less than 1% of total employees.

The annual charge for providing pollution control assumes a relatively modest role in relation to other cost factors. The ratio of this expenditure to the cost of materials or the value of shipments of the reporting industries was well under 1% in all industries and less than .05% in several of the industries. Thus, as a determinant of product cost the annual charge for maintaining abatement programs has been hardly significant. Both these measures may increase as plants add new treatment procedures or complete current capital programs for abatement facilities.

Projected Appropriations and Future Capital Requirements

The five-year experience in capital spending for pollution abatement facilities by the responding establishments indicates an expenditure for that period of $315 million. These establishments have estimated the spending level which will be required to meet present water quality standards at a projected $646 million, or roughly double the amount spent in the past five years.

On this basis, the surveyed industries report that one third of required construction programs to deal with present pollution problems had been completed and that an additional two thirds would be completed in the near future. Agreement between the volume of wastewater

requiring treatment and planned future capital commitments is underlined by statistics in the 1967 Census of Manufactures report, *Water Use in Manufacturing*, which indicate that almost 32% of the water volume discharged in 1968 by the seven industries surveyed had undergone treatment.

Wastewater Volume and Characteristics

The surveyed industries reported a daily discharge of 7.8 billion gallons of wastewater, of which 7.3 billion gallons, or 92.9% of total volume, was discharged directly to surface waters. Only 5.0% was discharged to public sewers and the remainder, 2.1%, by other means of disposal. The source of most of the wastewater was the manufacturing process but significant amounts of water were discharged from cooling processes as well.

The critical aspect of the water pollution problem refers not so much to the volume of wastewater discharged as to the effluent character of the water. The surveyed plants report a biochemical oxygen demand (BOD) content of 5 million pounds per day, a chemical oxygen demand (COD) content of over 6 million pounds per day, and suspended solids of 6 million pounds per day in the discharged waters. The paper industry and chemical industry contribute a major portion of the total effluent flow.

Public Sewer Use

Although only 5.0% of discharged wastewater from the surveyed plants flowed into public sewer systems, 85.4% of the plants with such facilities available to them used them for some portion of wastewater disposal. The use of public sewer systems required payment of some form by plants patronizing them. This expenditure amounted to over $7 million, paid by 289 plants. The most common method of payment was on the basis of water use. Charges based upon volume or strength of discharged wastewater accounted for a minor portion of the levies placed upon manufacturing establishments as a means of making public payments. Only $1.8 million for waste strength and overstrength charges was paid by 34 plants in 1969. Property tax assessments for financing of public sewer systems were levied against 96 plants for a total of $5.4 million. The amount paid by manufacturing plants as contributions to capital costs of public sewer systems amounted to $5.4 million, but this amount was paid by only 23 plants.

Wastewater Treatment Costs

The cost of providing in-plant treatment of wastewater must include the annual costs for operation and maintenance of the treatment system and a portion of the capitalization. The cost of using public facilities often eliminates the necessity for construction of physical facilities but generally requires the payment of specific governmental assessments for service rendered. The cost to industry of the two methods of disposal can be compared in only the most limited way by a determination of the unit cost of treatment, or the amount spent by industry in relation to the amount of wastewater treated.

The survey data for 288 plants using in-plant treatment procedures indicates a mean operating cost per volume of wastewater of $73 per million gallons. The payments to local governments by 209 plants using public sewer systems were made at a rate of $91 per million gallons of discharged wastewaters. Because the estimate of cost for in-plant treatment does not include the cost of capitalization of the treatment facilities, a comparison is not intended between these costs.

Geographic Factors in Pollution Control Costs

Another variable which enters into the cost equation of pollution control is the geographic location of the establishment and all of the natural and administrative influences such location may impart. However, the inability to isolate geographic location from all of the

other variables associated with it makes it difficult to assign a quantitative value to the differences which may be implied by location in a rural versus an urban area, or location in a particular region of the country.

Comments and Conclusions

The survey has produced a considerable amount of data which heretofore have not been available in any related form. The relationship between the capital expenditures already made for water pollution abatement facilities and those anticipated, coupled with a ratio of wastewater treated to the volume requiring treatment as reported in the 1967 Census of Manufactures *Water Use in Manufacturing*, provides the view that industry by 1969 had moved one of three paces toward achieving a level of water cleanliness based upon a standard of some treatment for all wastewater discharged. At that point in time, the projection for achieving this standard was set in the near future.

Additionally, the level of capital expenditures in relation to gross investment in plant, and the level of annual operating expenditures as a ratio of other cost factors, indicates that past expenditures for these purposes have not been unduly burdensome in most of the reporting plants. It is, however, possible that any level of expenditure might be burdensome in smaller plants or those of marginal productivity.

Capital Funds for Industrial Water Pollution Control

IN THE FIVE-YEAR PERIOD, 1965-1969, the 500 manufacturing establishments which made capital expenditures for water pollution control spent a total of $315,064,000 for such purposes. When the period began in 1965, 222 plants in seven major industrial categories were spending $33,159,000. In 1969, $112,592,000 was being spent by 365 plants, an increase of more than 239.5% in annual capital expenditures. (Table 1)

All of the industry categories in the survey indicated increased levels of spending. The smallest percentage gain was the 109.5% increase in expenditures by the textile mill products industry. The 595.7% increase in the petroleum products industry was the largest percentage rise. In dollar terms, the most significant increase was the almost $18 million climb in the chemicals and allied products industry. (Tables 2 and 3)

The number of establishments making expenditures for pollution abatement facilities rose 64.4% in the same period, from 222 making expenditures in 1965 to 365 in 1969.

In the period 1965 to 1969, the growth from year to year, while larger each year for the total industries, was at a decreasing percentage basis except for the growth from 1968 to 1969. That year's increase of 73.6% accounted for more than 60% of the five-year total increment.

The Effects of New Investment

Of 422 industrial establishments reporting expenditures in the years 1965 to 1969, only 98 reported that some substantial change had been made in the plant in that period. In some cases it was the construction of an entire new plant, in others the reconstruction of major portions of the plant or major adjustments in its production capacity. New plant construction involved only 29 of these establishments. The paper industry accounted for the largest number of new plants with eleven, of which five were new pulp mills.

In most of the new plants, the capital expenditures for pollution abatement equipment accounted for a larger ratio of gross investment than the ratio of capital expenditures to total gross investment in existing plants. (Table 4)

In those plants which reported either a major replacement of production equipment or

Table 1: Total Capital Expenditures for Water Pollution Abatement Facilities, by Industry, 1965-1969

Industry	1965-1969 No.	1965-1969 Amount ($000)
Food and kindred products	53	$ 9,583
Textile mill products	38	5,627
Paper and allied products	101	104,304
Chemicals and allied products	177	109,964
Petroleum products	46	52,399
Rubber and plastics products	24	8,936
Primary metals industries	61	24,251
Total	500	$315,064

Table 2: Increases in Plants Spending for Capital Improvements for Water Pollution Abatement, by Industry, 1965 and 1969

Industry	No. of Plants		Increase	
	1965	1969	No.	Per Cent
Food and kindred products	20	35	15	75.0%
Textile mill products	10	18	8	80.0
Paper and allied products	54	86	32	59
Chemicals and allied products	89	135	46	51.7
Petroleum products	24	37	13	54.2
Rubber and plastics products	4	12	8	200.0
Primary metal industries	21	42	21	100.0
Total	222	365	143	64.4%

Table 3: Increases in Capital Expenditures for Water Pollution Abatement Facilities, by Industry, 1965-1969

Industry	Expenditures ($000)		Increase	
	1965	1969	Amount($000)	Per Cent
Food and kindred products	$ 1,333	$ 3,118	$ 1,785	133.9%
Textile mill products	839	1,758	919	109.5
Paper and allied products	9,081	42,737	33,656	370.6
Chemicals and allied products	15,919	33,913	17,994	113.0
Petroleum products	2,972	20,675	17,703	595.7
Rubber and plastics products	73	430	357	489.0
Primary metal industries	2,942	9,961	7,019	238.6
Total	$33,159	$112,592	$79,443	239.6%

Table 4: Ratio of Five-year Capital Expenditures for Water Pollution Abatement Facilities to Gross Investment in Selected Categories, by Industry,

Industry	Total All Plants	Plants with No Improvements	New and Rebuilt Plants	New Plant Only
Food and kindred products	1.8%	.8%	2.5%	3.8%
Textile mill products	.8	.7	1.1	.8
Paper and allied products	2.3	2.1	2.9	3.4
Chemicals and allied products	1.0	1.0	.8	.9
Petroleum products	1.4	1.6	.6	–
Rubber and plastics products	1.5	1.6	.6	.6
Primary metal industries	.6	.4	1.1	2.4

a 50% increase in plant capacity in the last five years, the ratios of total expenditures to gross investment were within one tenth of 1% of each other for the affected industries and comparable to the pattern set in the other ratios. (Table 5)

One factor is evident in the foregoing set of ratios. In every instance, except for the 3.8% ratio posted in the food industry for new plant construction, the ratio of capital expenditure to gross investment was highest in the paper industry.

Capital Expenditures by Purpose

The pattern of expenditure over the five-year period was similar in each of the industries surveyed. A greater portion of the total

Table 5: Ratio of Capital Expenditures for Water Pollution Abatement Facilities to Gross Investment in Selected Categories, by Industry, 1965-1969

Industry	Ratio in Plants with 50% Capacity Increase	Ratio in Plants with 50% Replacement of Production Equipment
Food and kindred products	2.1%	2.0%
Textile mill products	.8	.8
Paper and allied products	2.5	2.6
Chemicals and allied products	.8	.9
Petroleum products	.7	.6
Rubber and plastics products	.4	.5
Primary metal industries	1.1	1.2

expenditure was spent for new facilities than for replacement and modernization of existing facilities.

In each of the industries, most plants allocated more of their abatement capital for wastewater treatment facilities than for any other purpose. The next most frequent application of capital was for manufacturing process changes. Expenditures for water cooling facilities occurred in only 35 of the reporting plants.

These factors seem to indicate that recent experience in pollution abatement has centered largely upon efforts to deal with the problem of pollution as a by-product of the manufacturing process to be treated at the end of the pipe, rather than as an integral element in the production process to be eliminated by process change. Perhaps insufficient time has elapsed to allow for adequate analysis of the manufacturing procedure which might accomplish the latter abatement procedure.

Size of Plant as a Factor in Pollution Abatement Expenditures

ALTHOUGH A PRESUMPTION was made that information would be more readily available about abatement activities from the larger industrial units, and particularly from those which were part of multiplant corporations, questionnaires were distributed to a smaller number of plants employing less than 100 people – 347, or 13.1% of the total sample. The response rate, running at 17% of the questionnaires sent to smaller firms, accounted for only 7.5% of the total of 789 responses received. Moreover, there were no responses from 19 of the 50 industry categories; and in only six of these categories were there three or more responses – five of the six were in the chemicals industry.

Another presumption held that information would be more readily available from plants belonging to multiplant companies. Questionnaires were sent to approximately 600 single-unit manufacturing companies, which accounted for 23% of the sample. The response rate was less than 6.5% of the 789 questionnaires answered, and was a return of only 8% of the questionnaires sent to single-unit plants. Of the 51 single-unit companies which did return completed questionnaires, 10 were from plants with under 100 employees, 20 were from plants with 100 to 500 employees, and the remaining 21 from plants with more than 500 employees.

The survey questionnaire was sent to 830 manufacturing establishments which employed 100 to 500 people. This was 31% of the sample selected, and 18% of the number of this sized unit in the selected universe. The 255 responses in this size category are 33% of the total response and almost 31% of the number distributed.

There were 1,477 manufacturing establishments employing 500 and more persons in the universe of 51 industry categories selected for the survey. All of these plants received questionnaires. A response came from 475 of these plants, a response rate of 32%, and this number accounts for 60% of the total response. This last size category is fairly evenly divided on the number of responses from companies with less than and companies with more than 1,000 employees.

Table 6: Capital Expenditures for Water Pollution Abatement Facilities, by Size of Plants, by Industry, 1969

Industry	Expenditures in Plants Employing 20-99 No.	20-99 Exp. ($000)	100-499 No.	100-499 Exp. ($000)	500-999 No.	500-999 Exp. ($000)	1000+ No.	1000+ Exp. ($000)
Food and kindred products	5	$583	10	$ 483	12	$ 1,242	7	$ 468
Textile mill products	0	–	3	407	9	483	6	868
Paper and allied products	2	115	31	10,034	23	6,620	29	23,879
Chemicals and allied products	5	100	40	5,797	38	9,451	48	18,162
Petroleum products	0	–	12	11,542	13	3,944	9	2,928
Rubber and plastics products	1	156	3	39	2	4	6	231
Primary metal industries	1	4	4	163	14	575	23	9,219
Total	14	$958	103	$28,465	111	$22.319	128	$57,755
Percentage Total	3.9%	0.87%	28.9%	25.9%	31.2%	20.4%	35.9%	52.7%

Table 7: Percentage Distribution of Capital Expenditures for Water Pollution Abatement Facilities, by Industry and Size of Plant, 1969

Industry	No. of Plants	Per Cent of Total Expenditures in Plants Employing				All Plants Reporting
		20-99	100-499	500-999	1000+	
Food and kindred products	34	7.4%	1.7%	5.5%	0.8%	2.0%
Textile mill products	18	–	1.4	2.2	1.5	1.6
Paper and allied products	85	28.4	35.3	29.7	44.8	39.1
Chemicals and allied products	131	24.7	20.4	42.3	31.4	30.8
Petroleum products	34	–	40.5	17.7	5.1	16.9
Rubber and plastics products	12	38.5	0.1	*	0.4	0.4
Primary metal industries	42	1.0	0.6	2.6	16.0	9.1
Total	356	100.0%	100.0%	100.0%	100.0%	99.9%

*Less than .05%

Information Availability

It has been noted that assumptions were made about the availability of information from plants which had certain characteristics. It was assumed that there would be a smaller response from plants which were single-unit operations and those with fewer employees. The response pattern on this survey reinforces this assumption. The smaller firms and the single-unit plants were less responsive because, as they stated, the desired information was not available or because they did not have the manpower to devote to making responses. Smaller plants often have made no efforts to deal with the problems of pollution, and may rationalize that their lack of size means that they contribute little to the cause of the problem.

That attitude may be contrasted with that of the multiplant employer who must maintain extensive records on all aspects of plant operations. The visibility of the larger employer to the public and to government requires that frequent disclosure of various types of information about the plant be made available. At times such information is transmitted merely for its public relations value.

Expenditures by Size of Plant

The predicted heavier response rate from the plants with the larger working force is reinforced by the amount of expenditures for abatement facilities made in 1969. The smallest units, those employing from 20 to 99 persons, accounted for less than 4% of the plants making capital expenditures in that year. However, the expenditures made by this group of plants was only 0.8% of the total spent. The largest establishments, those with 1,000 or more employees made up 35.9% of the plants and spent 52.7% of the total outlay. These data are significant only to accent the comparatively insignificant expenditures made by small plants as part of industry's total capital outlay. (Table 6)

The relative expenditures for capital purposes of the industries surveyed underlines further the contributions of two major industry categories as the leading spenders. Despite higher expenditures by a single manufacturer of tires with a plant employing less than 100 workers which accounted for 38.5% of the expenditure in the smallest plant size category, and the 40.5% of total expenditures in the 100 to 499 employees category by the petroleum industry, over 50% of total expenditures in each size category was attributable to the paper industry and the chemicals industry. Fully 60% of the 356 plants reporting capital expenditures in 1969 were in these two industries and they made almost 70% of the total expenditure. (Table 7)

The manufacturers of certain product lines are responsible for particularly significant por-

Table 8: Percentage Distribution of Capital Expenditures for Water Pollution Abatement Facilities, by Industry and Size of Plant, 1965-1969

Industry	No. of Plants	Per Cent of Total Expenditures in Plants Employing				All Sizes
		20-99	100-499	500-999	1000+	
Food and kindred products	52	7.0%	2.1%	5.6%	1.8%	2.8%
Textile mill products	38	–	0.7	2.0	2.2	1.8
Paper and allied products	100	20.5	44.0	34.3	28.7	33.4
Chemicals and allied products	173	53.9	21.3	33.4	42.1	35.5
Petroleum products	42	3.0	28.1	21.0	8.4	15.7
Rubber and plastics products	24	14.7	0.3	0.4	5.0	2.9
Primary metal industries	60	1.0	3.5	3.3	11.8	7.9
Total	489	100.0%	100.0%	100.0%	100.0%	100.0%

Table 9: Five-year Capital Expenditures for Water Pollution Abatement Facilities as a Per Cent of Gross Investment in Plant, by Industry and Size of Plant, 1969

Industry	Expenditures in Plants Employing							
	20-99		100-499		500-999		1000+	
	No. of Plants	Investment Ratio (%)	No. of Plants	Investment Ratio (%)	No. of Plants	Investment Ratio (%)	No. of Plants	Investment Ratio (%)
Food and kindred products	6	2.0%	13	3.0%	15	1.4%	12	.5%
Textile mill products	–	–	6	1.4	15	.9	14	.7
Paper and allied products	2	7.5	35	3.4	27	2.2	28	1.9
Chemicals and allied products	12	2.0	45	.9	40	1.1	43	.9
Petroleum products	2	.6	9	6.0	11	.9	5	.8
Rubber and plastics products	2	39.5	6	.7	4	.7	9	.1
Primary metal industries	2	1.3	8	2.1	16	.5	32	.5
Total	26	2.4%	122	2.4%	128	1.3%	143	.9%

tions of these 1969 expenditures. The tire maker and the petroleum refineries already mentioned as making the largest expenditures in the under 100 and 100 to 499 employee categories were joined by the paperboard mills, making expenditures totaling 25.9% in the small plant group, and by pulp mills and paper mills, together accounting for 20.1% of the expenditures in plants having 100 to 499 workers. In the larger plants, the paper mills accounted for 17.7% of expenditures in plants with over 500 employees and 33.4% of expenditures in plants with over 1,000 employees. The organic chemicals plants contributed 14.7% and 13.3% of the expenditures in these size categories. Viewing the industries without regard to size of plant, the leading expenditures were made by the paper mills, 25%, the petroleum refineries, 16.9%, and the organic chemicals manufacturers, 10.7%.

Distribution of Five-year Expenditures

The capital expenditures for the period 1965 to 1969 reflect the single-year apportionment pattern – the major portion of industrial expenditures in the paper and chemical industries. Together these industries contributed almost 69% of the total five-year expenditure, and in each of the four plant size categories accounted for over 60% of the total amount spent. (Table 8)

Of the 51 product lines included in the survey, five were responsible for over 60% of the cumulative capital expenditures from 1965 to 1969. These were the paper mills, with a

Table 10: Five-year Capital Expenditures for Water Pollution Abatement Facilities as a Per Cent of Book Value of Plant, by Industry and Size of Plant, 1969

Industry	Expenditures in Plants Employing: 20-99 No. of Plants	20-99 Book Value Ratio (%)	100-499 No. of Plants	100-499 Book Value Ratio (%)	500-999 No. of Plants	500-999 Book Value Ratio (%)	1000+ No. of Plants	1000+ Book Value Ratio (%)
Food and kindred products	6	3.8%	14	4.3%	14	2.4%	13	1.1%
Textile mill products	–	–	4	1.0	13	1.3	10	1.2
Paper and allied products	2	25.1	35	4.5	27	3.5	30	3.7
Chemicals and allied products	12	3.3	43	1.7	38	2.3	42	2.1
Petroleum products	2	1.3	9	18.9	11	1.9	5	1.9
Rubber and plastics products	2	21.5	6	1.1	4	1.2	9	.3
Primary metal industries	2	3.4	8	3.1	16	.9	32	1.2
Total	26	4.4%	119	4.3%	123	2.4%	141	2.0%

Table 11: Mean Capital Expenditures per Plant for Water Pollution Abatement Facilities, by Industry and Size of Plant, 1969

Industry	Per Plant Expenditures ($) in Plants Employing: 20-99	100-499	500-999	1000+
Food and kindred products	$ 6,000	$ 48,300	$103,500	$ 66,900
Textile mill products	–	135,700	53,700	144,700
Paper and allied products	57,500	323,700	287,800	892,400
Chemicals and allied products	20,000	144,900	248,700	378,400
Petroleum products	–	961,800	303,400	325,300
Rubber and plastics products	156,000	13,000	2,000	38,500
Primary metal industries	4,000	40,800	41,100	400,820
Mean all industries	$ 28,900	$276,400	$201,100	$451,210

percentage of expenditure of 19.8%; petroleum refineries, with 15.7%; organic chemicals, 10.8%; pulp mills, 8.3%; and inorganic chemicals, 6.9%. These also were the industries which spent more than $20 million each for the five-year span.

Expressed in terms of a ratio of capital expenditure for water pollution abatement facilities to the gross investment in plant, or to the book value of plant, the expenditure by the smaller plants represented a higher level of new investment. This level of capital expenditure to gross investment for all plants responding was 2.42% and 2.48% for plants with less than 100, and less than 500 employees, respectively, and 1.3% and 0.9% for the larger sized plants. (Table 9)

The book value ratios also were higher for the smaller plants and became increasingly smaller as the size of the plant increased. (Table 10)

Capital Expenditures per Plant

Another measure of significance is the amount which has been allocated for water pollution abatement purposes by the individual plants or the annual mean expenditure by plant within an industrial category. Thus, for the 356 manufacturing establishments which provided the necessary data, the mean expenditure in 1969 was $306,000 for construction of water pollution abatement facilities. In the 14 plants with less than 100 employees the mean annual per plant expenditure was $28,900 dollars, and for the 128 plants in the

Table 12: Mean Capital Expenditures per Plant for Water Pollution Abatement Facilities, by Industry and Rank, 1969

Industry	No. of Plants	1969 Expenditures	Per Plant Expenditures	Rank
Food and kindred products	34	$ 2,223,000	$ 65,400	6
Textile mill products	18	1,758,000	97,700	5
Paper and allied products	85	42,648,000	501,700	2
Chemicals and allied products	131	33,510,000	255,800	3
Petroleum products	34	18,414,000	541,600	1
Rubber and plastics products	12	430,000	35,800	7
Primary metal industries	42	9,961,000	237,200	4
Total	356	$106,944,000	$306,000	

Table 13: Percentage Distribution of Annual Operating Expenditures of Water Pollution Abatement Facilities, by Size of Plant and by Industry, 1969

Industry	Per Cent of Total Expenditures in Plants Employing				All Plants
	20-99	100-499	500-999	1000+	
Food and kindred products	5.8%	3.4%	4.2%	1.1%	2.2%
Textile mill products	–	0.4	1.2	2.8	2.1
Paper and allied products	3.9	32.1	16.8	12.2	15.8
Chemicals and allied products	79.9	52.3	55.4	62.2	59.5
Petroleum products	10.1	9.5	17.8	10.4	12.0
Rubber and plastics products	0.2	0.1	0.3	0.4	0.3
Primary metal industries	–	2.0	4.3	10.9	8.1
Per cent of total of all plants	0.8%	13.0%	23.8%	62.4%	100.0%

Table 14: Operating Expenditures per Plant for Water Pollution Abatement Facilities by Size of Plant, and by Industry, 1969

Industry	Mean per Plant Expenditures ($) in Plants Employing				
	20-99	100-499	500-999	1000+	20-1000+
Food and kindred products	$ 5,000	$16,200	$ 43,700	$ 32,800	$ 27,100
Textile mill products	–	6,200	13,100	103,100	43,700
Paper and allied products	10,000	93,900	124,500	184,200	130,800
Chemicals and allied products	31,500	71,500	192,000	391,000	210,300
Petroleum products	13,000	80,900	213,200	471,200	218,700
Rubber and plastics products	1,000	1,800	11,000	12,700	9,400
Primary metal industries	–	28,500	35,700	139,200	93,100
Expenditure per plant, by size	$19,700	$62,300	$119,000	$240,200	$141,300

more than 1,000 workers category the mean expenditure was $451,210 per plant. However, there is no definite pattern of relationship between size of plant and per plant expenditures in most of the industries. Nevertheless, it is notable that mean annual per plant expenditures in the paper and allied products industry were consistently larger than the mean expenditures for all industry in each plant size category. (Table 11)

In the separate product classification, there were a number of cases of mean expenditures of over $1 million per plant. These expenditures were reported in pulp mills, in paper

mills, in petroleum refineries, and in copper rolling plants. (Table 12)

Distribution of Annual Operating Expenditures

One industry spent more than the total spent by the other six industrial categories for operation of water pollution abatement facilities in 1969. The chemicals industry spent $38.9 million, or 59.5% of the total spent by all the industries in that year. The chemicals industry and the paper industry together accounted for 75.3% of the total expenditure. The chemicals, paper and petroleum industries together accounted for 87.3% of the total.

Taken by size of plant, more than 62.0% of the amount spent in 1969 came from plants with 1,000 or more employees, and 86.2% was expended by plants with more than 500. These two size categories represented 65% of the plants responding to this question. Thus, for the plants with less than 500 employees, 35% spent little more than 13% of the total for operation of pollution facilities. (Table 13)

Operating Expenditure per Plant

The plants which made the large capital expenditures for pollution control facilities were the leading spenders for the operation of these facilities. The paper mills, the oil refineries, and the manufacturers of organic chemicals and inorganic chemicals spent more than $30 million, or 47% of the amount spent by all plants reporting operating expenditures in 1969.

The effective rate of expenditure for operating purposes for the individual plant in 1969 was $141,300 for all industries and for all size plants. For plants with less than 100 employees, the mean per plant expenditure was $19,700, while the expenditure for plants employing more than 1,000 persons was $240,200. The industries which made the large per plant expenditures, chemicals and petroleum, also had per plant expenditures above the mean per plant expenditure for all of the industries. The leading per plant expenditure was the $4.2 million spent by 9 petroleum refineries, a mean expenditure of $471,200 per plant. (Table 14)

Expenditures for Operation and Maintenance of Pollution Abatement Facilities

FEW MEASURES OF pollution control activity serve as well as the continuing annual expenditures for the operation and maintenance of pollution control equipment and programs. This expenditure translates into cost factors the investment made for capital equipment and provides a year-to-year basis for gauging the extent of pollution control activity. The personnel costs associated with this activity and the concomitant operational expenses are part of the cost of producing a product and an element in the profitability of plant operations.

In 1969, among the 500 plants which reported expenditures for the construction of abatement facilities for the preceding five-year period, 463 or 92.6%, noted expenditures for operation and maintenance totaling $65,405,000. (Table 15)

In 406 plants, with a minimum of one full-time employee assigned to pollution control work, a total of 2,018 people were employed in the operation of pollution abatement facilities. For these 406 plants the annual operating expenditure was $54,942,000 and the mean expenditure per operating employee was $27,225. (Table 16)

Operations Expenditures in the Cost Picture

The personnel costs associated with operation of abatement facilities are part of the total personnel costs of the plant. In a very small plant, a single abatement operations employee would account for 2% of the total employment of a plant with 50 employees. This is the case with one plant responding to the survey. However, the percentage of employees on an over-all industry basis is lower. The ratio of abatement employees to total employment ranges from a high of 1% in the petroleum industry to .1% ratios in the textile mill products industry and the rubber and plastics products industry. In more specific industrial categories, two industries, the inorganic chemicals manufacturers and the fertilizer

Table 15: Annual Operating Expenditures of Water Pollution Abatement Facilities, by Size of Plant, and by Industry, 1969

Industry	Expenditures in Plants Employing							
	20-99		100-499		500-999		1000+	
	No.	Exp. ($000)	No.	Exp. ($000)	No.	Exp. ($000)	No.	Exp. ($000)
Food and kindred products	6	$ 30	18	$ 292	15	$ 655	14	$ 459
Textile mill products	–	–	6	37	14	183	11	1,134
Paper and allied products	2	20	29	2,724	21	2,614	27	4,973
Chemicals and allied products	13	410	62	4,435	45	8,640	65	25,415
Petroleum and coal products	4	52	10	809	13	2,772	9	4,241
Rubber and plastics products	1	1	5	9	4	44	12	152
Primary metal industries	–	–	6	171	19	678	32	4,455
Total	26	$513	136	$8,477	131	$15,586	170	$40,829

Table 16: Number of Employees Engaged in Water Pollution Abatement Activities, by Industry, 1969

Industry	*Abatement Employees*	*Operations Expenditures*	*Expenditures per Employee*
Food and kindred products	123	$ 1,432,000	$11,642
Textile mill products	42	1,282,000	30,524
Paper and allied products	390	9,014,000	23,112
Chemicals and allied products	986	32,993,000	33,461
Petroleum products	237	4,756,000	20,068
Rubber and plastics products	22	191,000	8,682
Primary metal industries	218	5,274,000	24,193
Total	2,018	$54,942,000	$27,225

Table 17: Ratio of Water Pollution Abatement Employees to Production Employees and to Total Employees, by Industry, 1969

Industry	*Per Cent Abatement Employees to Production Employees*	*Per Cent Abatement Employees to Total*
Food and Kindred Products (20)	.4%	.3%
Meat slaughtering plants (2011)	.2	.2
Poultry dressing plants (2015)	.5	.4
Cheeses (2022)	2.4*	2.0*
Fluid milk (2026)	.8	.2
Seafoods (2031)	–	–
Canned fruits/vegetables (2033)	.4	.4
Fish (2036)	.1*	.1*
Frozen fruits/vegetables (2037)	.5	.4
Wet corn milling (2046)	.5	.4
Raw cane sugar (2061)	.5	.5
Cane sugar refining (2062)	–	–
Malt liquors (2082)	–	–
Distilled liquor, not brandy (2085)	.4*	.3*
Textile Mill Products (22)	.1	.1
Weaving mills, cotton (2211)	.1	.1
Weaving mills, synthetics (2221)	.1	.1
Weaving, finishing mills, wool (2231)	.2	.2
Finishing plants, cotton (2261)	.2	.2
Finishing plants, synthetic (2262)	.1*	.1*
Paper and Allied Products (26)	.7	.6
Pulp mills (2611)	1.1	.9
Paper mills, not building (2621)	.6	.5
Paperboard mills (2631)	.8	.6
Paper products (2641)	1.1	.9
Building paper-board mills (2661)	.7	.5
Chemicals and Allied Products (28)	.7	.5
Alkalies/chlorine (2812)	.8	.5
Coal tar products (2815)	1.0	.6
Organic chemicals (2818)	1.3	.9
Inorganic chemicals (2819)	2.0	1.4
Plastics/resins (2821)	.4	.3
Synthetic rubber (2822)	.7	.5
Cellulosic man-made fibers (2823)	.4	.3
Organic fibers, noncellulosic (2824)	.4	.3
Pharmaceuticals (2834)	.4	.2

(Table continued on page 16)

Table 17: Ratio of Water Pollution Abatement Employees to Production Employees and to Total Employees, by Industry, 1969 (continued)

Industry	*Per Cent Abatement Employees to Production Employees*	*Per Cent Abatement Employees to Total*
Detergents (2841)	.3	.2
Gum and wood chemicals (2861)	.7*	.6*
Fertilizers (2871)	2.3	1.7
Agricultural pesticides (2879)	1.2	.5
Glue and gelatin (2891)	.2	.1
Explosives (2892)	.2	.1
Carbon black (2895)	.6	.5
Petroleum Products (29)	1.3	1.0
Petroleum refining (2911)	1.3	1.0
Lubricating oils/greases (2992)	.6*	.5*
Rubber and Plastics Products, n.e.c. (30)	.1	.1
Tires/tubes (3011)	.1	**
Rubber products (3069)	.2	.1
Plastics products (3079)	.2	.1
Primary Metal Industries (33)	.2	.2
Blast furnaces/steel mills (3312)	.3	.2
Steel pipe/tube (3317)	.2	.2
Iron foundries (3321)	.1	.1
Primary copper (3331)	.5	.3
Primary aluminum (3334)	.2	.2
Copper rolling/drawing (3351)	.3	.3
Aluminum rolling/drawing (3352)	.2	.2

*Based upon data from a single plant
**Less than .05%

manufacturers in the chemicals industry, posted high ratios of abatement employees to total employees, with 1.4% and 1.7% respectively. In all of these cases, the high ratio is largely attributable to a lower level of total employment. The petroleum industry has characteristically been a low manpower industry.

Since the abatement operations activity would be classified as part of the production process and the employees included in the production employee category, a ratio of abatement employees to production employees was developed. In the petroleum industry the ratio rises to 1.3% of production employees; and it goes substantially higher to 2.3% in the fertilizer industry and to 2.0% in the inorganic chemicals manufacturers. (Table 17)

When measured in terms of the total payroll, the annual operating expenditure assumes a more important position in the cost picture than would initially be adjudged by the ratio of numbers of employees involved in pollution control operations. (Table 18)

The high ratio in the petroleum industry would be attributable to a combination of higher expenditure and fewer employees.

Operating Expenditures and Production Employees

The ratio of expenditure for annual operation and maintenance functions to the number of production employees provides some measure of per capita expenditure for this purpose. The annual cost per production worker has a greater effect in the small plant despite the smaller total expenditure. However, some industries which utilize smaller work forces because of a high degree of automation

Table 18: Ratio of Annual Operating Expenditures for Water Pollution Abatement Facilities to Total Payroll, 1969

Industry	Number	Ratio
Food and kindred products	49	.4%
Textile mill products	29	.7
Paper and allied products	79	1.6
Chemicals and allied products	168	1.7
Petroleum products	22	2.4
Rubber and plastics products	21	.1
Primary metal industries	53	.5
Total	421	1.2

Table 19: Annual Operating Expenditures for Water Pollution Abatement Facilities per Production Employee, by Size of Plant and by Industry, 1969

	Expenditures per Production Worker in Plants Employing							
	20-99		100-499		500-999		1000+	
Industry	No.	Expenditures	No.	Expenditures	No.	Expenditures	No.	Expenditures
Food and kindred products	6	$111	18	$ 73	16	$ 69	14	$ 23
Textile mill products	–	–	6	26	14	21	11	49
Paper and allied products	2	182	29	359	21	233	27	135
Chemicals	13	806	56	363	43	399	62	211
Petroleum products	3	410	8	385	12	359	6	396
Rubber and plastics products	1	25	5	5	3	23	12	7
Primary metals industries	–	–	6	114	19	64	31	58
Total	25	$486	128	$275	128	$214	163	$125

Table 20: Ratio of Annual Operating Expenditures for Water Pollution Abatement Facilities to Gross Capital Investment, by Size of Plant and by Industry, 1969

	Ratio in Plants Employing							
	20-99		100-499		500-999		1000+	
Industry	No.	Ratio	No.	Ratio	No.	Ratio	No.	Ratio
Food and kindred products	6	.6%	15	.4%	13	.2%	13	.1%
Textile mill products	–	–	6	.1	13	.1	10	.3
Paper and allied products	2	.5	27	.4	21	.3	27	.3
Chemicals and allied products	13	.9	50	.3	39	.4	45	.3
Petroleum products	3	.5	6	.4	10	.2	4	.2
Rubber and plastics products	–	–	5	*	3	.1	11	*
Primary metal industries	–	–	6	.1	18	.1	31	.1
Total	24	0.8%	115	0.3%	117	0.3%	141	0.2%

*Less than .05%

will also indicate a larger per man expenditure but not bear the same burden on the cost of production. (Table 19)

The mean expenditure per production worker for the 444 plants reporting was $152. Three industries – paper, chemicals, and petroleum – reported larger per worker expenditures in most instances.

Operating Expenditures and Capital Investment

The size of the manufacturing establishment, measured by the number of employees, is a significant factor in viewing the extent to which plants have made physical improvements for dealing with the water pollution problem.

Table 21: Ratio of Annual Operating Expenditures for Water Pollution Abatement to Plant Book Value, by Size of Plant and by Industry, 1969

Industry	Ratio in Plants Employing							
	20-99		100-499		500-999		1000+	
	No.	Ratio	No.	Ratio	No.	Ratio	No.	Ratio
Food and kindred products	6	1.0%	17	.5%	13	.5%	14	.2%
Textile mill products	–	–	4	.1	11	.1	8	.5
Paper and allied products	2	1.7	26	.6	21	.4	27	.6
Chemicals and allied products	12	1.5	47	.6	37	.7	44	.7
Petroleum products	3	1.2	6	1.0	10	.4	4	.4
Rubber and plastics products	1	.2	5	.1	3	.2	11	*
Primary metal industries	–	–	6	.2	17	.3	31	.3
Total	24	1.4%	111	0.6%	112	0.5%	139	0.5%

*Less than .05%

As anticipated, the larger expenditures, in total and on a per plant basis, were made by larger plants. The size of the plant is decidedly more important in the consideration of amounts spent for operation and maintenance of pollution control facilities because of the continuity of this measure and the inclusion of selected variables which may be comparable on a year-to-year basis.

Significant differences in the ratio of annual operating expenditures to other variables occurs mainly in the ratios for plants with less than 100 employees where the percentage of annual expenditure is consistently larger.

The mean ratio of annual operating expenditure to the total capital investment for the 397 plants reporting these data was 0.25%. The plants with less than 100 employees reported a ratio of 0.8%, while the mean ratios for the other size categories were 0.3%, 0.3%, and 0.2%. (Table 20)

A similar pattern evolved for the ratio of annual operating expenditures to the book value of the responding plants. In this case, the 386 respondents allocated 0.5% of the book value of the plants for operating pollution control facilities in 1969. The small plant ratio was again markedly higher at 1.4%. (Table 21)

Projected Appropriations for Pollution Abatement Facilities

IN GENERAL, capital appropriation programs are long-term efforts, since they are conceived, financed, and constructed over a span of years. Most pollution control projects require similar handling and are, in some instances, major additions to existing plant and equipment. Therefore, capital construction programs begun within the period of the survey, 1965 to 1969, may be continued for several years.

Planned appropriations for 1970 and beyond were reported by 422 plants. Of this number, 295 had made expenditures in 1969 and 363 had made expenditures in the previous five-year period. The total planned appropriations for 1970 reported by all of the industries were $252,854,000 – more than double the reported 1969 expenditures. (Table 22)

Future Capital Requirements

The amount projected as future capital requirements which will be necessary to meet present water quality standards, including the amount allocated for expenditure in 1970, is $646,671,000. This projected capital requirement reported by 445 manufacturing establishments exceeds the 1970 anticipated expenditure by more than 155%, is almost six times the amount of the 1969 expenditure, and is more than double the amount spent by 500 plants from 1965 to 1969. (Table 23)

The assumption that might be drawn from this expression of future intent by the reporting companies is that they had in 1969, after making expenditures over the previous five-year period, come one third of the way toward meeting present water quality standards. The 1970 appropriation will add considerably to this amount and will move these companies more than halfway toward meeting the presently identified water quality standards.

The greatest portion of this capital requirement would be met within five years according to 419 plants which reported on the number of years in which they planned to spend their future appropriations. (Table 24)

The largest percentage of the companies, 62%, reported that the expenditures would be made for wastewater treatment facilities, while 31% indicated that the money would be used for manufacturing process changes. The remaining 7% would divide their expenditures

Table 22: Planned Capital Appropriations for 1970 for Water Pollution Abatement Facilities, by Industry

Industry	*Number of Plants*	*1970 Appropriations ($000)*
Food and kindred products	37	$ 6,261
Textile mill products	25	4,107
Paper and allied products	85	77,182
Chemicals and allied products	160	87,964
Petroleum products	46	59,754
Rubber and plastics products	13	1,545
Primary metal industries	56	16,041
Total	422	$252,854

Table 23: Future Capital Requirements for Water Pollution Abatement Facilities for 1970 and the Future To Meet Present Water Quality Standards, by Industry, 1969

Industry	Number of Plants	Future Capital Requirements ($000)
Food and kindred products	37	$ 19,410
Textile mill products	32	9,389
Paper and allied products	85	189,356
Chemicals and allied products	167	273,098
Petroleum products	46	70,172
Rubber and plastics products	19	3,220
Primary metal industries	59	82,026
Total	445	$646,671

Table 24: Time Pattern of Capital Appropriations for Future Expenditures for Water Pollution Abatement Facilities, by Industry, 1969

Industry	No.	Number of Companies Making Expenditures in: 1 Year	2 Years	3 Years	4 Years	5 Years	6 Years	7 Years	8 Years	8+ Years
Food and kindred products	35	7	10	5	2	6	0	0	0	5
Textile mill products	32	15	9	2	1	3	0	0	0	2
Paper and allied products	81	9	28	20	8	10	4	1	0	1
Chemical and allied products	166	30	35	36	15	46	2	1	0	1
Petroleum products	27	9	3	7	3	4	0	0	0	1
Rubber and plastics products	19	5	6	1	1	2	0	0	0	4
Primary metal industries	59	15	15	10	4	13	1	0	1	0
Total	419	90	106	81	34	84	7	2	1	14

between cooling facilities and pools for storage and aeration.

Projected Annual Operating Expenditures

The 463 plants indicating annual expenditures for operating pollution control facilities in 1969 report an expenditure of $65 million. These plants, and an additional 89 plants, project an annual expenditure upon completion of the presently planned abatement facilities construction program of $95 million per year – an anticipated rise of 46.4%. The effective date of this increased level of annual spending is indefinite and dependent upon completion of the construction program, which in some cases is anticipated to run beyond an eight-year period.

Measures of Effort in Pollution Control

THERE ARE FEW available measures of pollution abatement activity, Capital expenditures for the construction of abatement facilities and the annual expenditures for operation and maintenance of these facilities are two methods by which effort is gauged. Perhaps the ideal method of measuring water pollution control efforts would be the continuous monitoring in all plants of all wastewater discharges.

Lacking this level of sophistication, some determinant might be developed that would indicate to what extent industry is attempting to cope with the problems of industrial pollution. Utilizing existing indicators of productivity, combined with a record of company commitment by way of physical facilities for the control of pollution and the annual operating cost of these facilities, one might create an experiential ratio by which to measure future abatement activity. It may be difficult to defend the economic validity of this type of yardstick because of the absence of a real relationship between the variables. Nevertheless, it would seem that the level of pollution rises with the increase of production, if the pollution results from the manufacturing process. At the same time, an increase in the funds allocated to operation of pollution control facilities indicates a greater effort to reduce the level of pollution.

It should be noted that these measures of growth are valuable only as general trend indicators and would be inadequate for application as individual plant standards.

Cost of Materials as a Measure

Besides the payroll expense, the cost of materials provides another major component of the cost of production. (Table 25)

The ratio of annual operating expenditures to the cost of materials in the manufacturing proce , in plants with less than 100 employees is 0.7%, while in the larger plants it runs at lower ratios. In many of the plants the ratio is less than .05%. (Table 26)

In 40 of the responding plants, it would be necessary to include in the cost of abatement operations the amount paid to a municipality for the use of the public sewer system because of pretreatment of effluent discharged into public sewers. The two industries in which this practice occurs most frequently are meat slaughtering plants and the manufacturers of detergents.

Table 25: Ratio of Annual Operating Expenditures for Water Pollution Abatement to Cost of Materials, 1969

Industry	*Number*	*Ratio (%)*
Food and kindred products	49	.1
Textile mill products	28	.2
Paper and allied products	79	.7
Chemicals and allied products	135	.6
Petroleum products	19	.2
Rubber and plastics products	20	*
Primary metal industries	52	.2
Total	382	.5

*Less than .05%

Table 26: Ratio of Annual Operating Expenditures for Water Pollution Abatement to Cost of Materials, by Size of Plant and by Industry, 1969

Industry	Ratio in Plants Employing 20-99 No.	20-99 Ratio	100-499 No.	100-499 Ratio	500-999 No.	500-999 Ratio	1000+ No.	1000+ Ratio
Food and kindred products	5	0.1%	17	0.1%	13	0.1%	14	*%
Textile mill products	–	–	4	0.2	13	0.1	11	0.2
Paper and allied products	2	0.7	28	1.1	21	0.7	27	0.6
Chemicals and allied products	12	1.2	45	0.6	37	0.7	40	0.5
Petroleum products	3	0.4	4	0.2	10	0.2	2	0.3
Rubber and plastics products	1	0.1	5	*	3	0.1	11	*
Primary metal industries	–	–	6	0.2	16	0.2	30	0.2
Total	23	0.7%	109	0.5%	113	0.4%	135	0.3%

*Less than .05%

Table 27: Ratio of Capital Expenditures for Water Pollution Abatement to Value of Shipments, 1969

Industry	Number	Capital Expenditures ($000)	Value of Shipments ($000)	Ratio
Food and kindred products	30	2,800	1,641,323	.2%
Textile mill products	15	1,668	593,427	.3
Paper and allied products	78	33,300	2,623,492	1.3
Chemicals and allied products	91	21,345	5,311,421	.4
Petroleum products	17	14,584	2,792,576	.5
Rubber and plastics products	12	430	646,631	.1
Primary metal industries	39	8,914	3,375,630	.3
Total	282	83,041	16,984,500	0.5%

Table 28: Ratio of Annual Operating Expenditures for Water Pollution Abatement to Value of Shipments, 1969

Industry	Number	Ratio (%)
Food and kindred products	49	*
Textile mill products	27	.1
Paper and allied products	74	.4
Chemicals and allied products	128	.3
Petroleum products	19	.2
Rubber and plastics products	20	*
Primary metal industries	52	.1
Total	369	.2%

*Less than .05%

Value of Shipment as a Measure

The value of shipments may be defined as the gross value of products shipped in a particular year. It is not in itself a measure of profitability, but it does provide a scale by which to judge the amount of productive activity of a manufacturing establishmen.

In 1969, 282 plants which made capi.' expenditures for pollution abatement facilities amounting to $83,041,000 reported shipments valued at $16,984,500,000. The ratio of capita'

Table 29: Ratio of Annual Operating Expenditures for Water Pollution Abatement to Value of Shipments, by Size of Plant and by Industry, 1969

Industry	Ratio in Plants Employing 20-99 No.	20-99 Ratio	100-499 No.	100-499 Ratio	500-999 No.	500-999 Ratio	1000+ No.	1000+ Ratio
Food and kindred products	5	0.1%	17	0.1%	13	0.1%	14	*%
Textile mill products	–	–	4	0.1	13	0.1	10	0.2
Paper and allied products	2	0.5	27	0.6	20	0.4	25	0.3
Chemicals and allied products	12	0.1	44	0.3	34	0.4	38	0.2
Petroleum products	3	0.2	4	0.2	10	0.1	2	0.2
Rubber and plastics products	1	0.1	5	*	3	0.1	11	*
Primary metal industries	–	–	6	0.1	16	0.1	30	0.1
Total	23	0.4%	107	0.3%	109	0.3%	130	0.2%

*Less than .05%

expenditure for pollution facilities to the value of shipments was .5%. (Table 27)

The ratio of annual operating expenditures to the value of shipments provides a measure that can be utilized on a continuing basis since both variables are ongoing expenditures rather than the singular appropriation for capital construction purposes.

In 1969, the 369 establishments with operational pollution control programs spent $41,754,000 for this purpose. These same plants accounted for product value of shipments amounting to $20,643,715,000. The ratio of annual operating expenditures to the value of shipments for these plants was 0.2%. (Table 28)

This ratio, when applied to the plants according to size of plant, provides a range running from a high of 0.4% for plants employing less than 100 persons to a low of 0.2% for those employing more than 1,000. (Table 29)

The paper industry ratio at .4% and the chemical industry with .3% were the only ones which exceeded the mean ratio value of .2%. In the food industry and rubber and plastics industry the operational expenditures accounted for less than .05% of value of shipments. The latter also made the smallest capital expenditure ratio.

Other Measures of Productivity

The value-of-shipments datum is used in compiling other standards measures, such as a rough equivalent of value added by manufacture, which is obtained by subtracting from the value of shipments the amount applicable to materials, fuels, and supplies put into production and the annual depreciation

Table 30: Ratio of Capital Expenditures for Water Pollution Abatement to Value Added, 1969

Industry	Number	Capital Expenditures ($000)	Value Added ($000)	Ratio
Food and kindred products	27	2,503	423,447	.6%
Textile mill products	12	1,518	169,554	.9
Paper and allied products	77	33,290	1,077,698	3.1
Chemicals and allied products	84	20,216	2,424,645	.8
Petroleum products	17	14,584	880,817	1.7
Rubber and plastics products	12	430	423,119	.1
Primary metal industries	38	8,912	1,219,047	.7
Total	267	81,453	6,618,327	1.2%

Table 31: Ratio of Annual Operating Expenditures for Water Pollution Abatement to Value added by Manufacture, by Size of Plant, by Industry, 1969

Industry	Ratio in Plants Employing 20-99 No.	20-99 Ratio	100-499 No.	100-499 Ratio	500-999 No.	500-999 Ratio	1000+ No.	1000+ Ratio
Food and kindred products	2	1.7%	15	0.1%	12	0.3%	14	0.1%
Textile mill products	–	–	4	0.4	13	0.2	10	0.6
Paper and allied products	–	–	27	1.5	20	1.0	25	0.7
Chemicals and allied products	10	1.4	41	0.6	33	0.8	36	0.4
Petroleum products	3	0.8	4	1.5	10	0.3	2	1.8
Rubber and plastics products	1	0.3	4	*	2	0.1	10	*
Primary metal industries	–	–	5	0.3	16	0.3	29	0.3
Total	16	1.3%	100	0.7%	106	0.6%	126	0.4%

*Less than .05%

Table 32: Ratio of Annual Operating Expenditures for Water Pollution Abatement to Gross Operating Margin, by Size of Plant, by Industry, 1969

Industry	Ratio in Plants Employing 20-99 No.	20-99 Ratio	100-499 No.	100-499 Ratio	500-999 No.	500-999 Ratio	1000+ No.	1000+ Ratio
Food and kindred products	2	3.7%	15	0.2%	12	0.5%	14	0.3%
Textile mill products	–	–	4	1.1	13	0.5	10	1.7
Paper and allied products	–	–	27	2.7	20	1.9	25	1.9
Chemicals and allied products	10	1.6	41	0.9	33	1.2	36	0.8
Petroleum products	3	1.0	4	2.7	10	0.3	2	5.3
Rubber and plastics products	1	1.2	4	0.2	2	0.2	10	*
Primary metal industries	–	–	5	0.4	16	0.6	29	0.5
Total	16	1.6%	100	1.0%	106	0.8%	126	0.7%

*Less than .05%

charged. Another is the gross operating margin, which is computed by subtracting the payroll cost from the amount of value added by manufacture.

In 1969, manufacturing establishments which made capital expenditures in that year posted a total amount of value added by manufacture equivalent to $6,618,327,000. These same plants made capital expenditures for abatement facilities of $81,453,000. The ratio of capital expenditures to the value added by manufacture for these 267 plants was 1.2%. (Table 30)

In the same year, 348 plants with annual operating expenditures for pollution abatement activities of $38,360,000 accounted for an amount of value added by manufacture of $8,331,013,000, a ratio of 0.5%. (Table 31)

These same plants, with a gross operating margin of $4,776,113,000 had a ratio of annual operating expenditure to gross operating margin of .8%. (Table 32)

Wastewater Volume and Characteristics

THE PLANTS REPORTING discharges of wastewater indicated a predominant tendency to discharge directly into a stream or other body of water, rather than into public sewer systems. The ratio of volume discharged directly to the total volume discharged for all industry was 92.9%. It ranged from a high of 98.0% in the petroleum industry and 96.7% in the chemicals industry to a low level of 66.1% in the rubber and plastics products industry. The volume of wastewater discharged to public sewers, as a consequence, received a high percentage of 32.7% of the total discharge in the rubber and plastics products industry and 23.0% in the food industry. Wastewater discharged to other facilities than streams or public sewers, such as deep wells or aeration pools, accounted for a meaningful portion of the discharge only in the primary metals industry where 11.3% of the wastewater was disposed of in this way. (Table 33)

The percent volume discharged by disposal area conforms to the percentages indicated in the 1967 Census of Manufacturers *Water Use in Manufacturing*. In that report, 91.9% of the wastewater was discharged directly, 5.4% was discharged to public sewers and 2.7% was discharged elsewhere. The total volume of discharge in the industrial establishments surveyed was in excess of 7.8 billion gallons per day -- 7.3 billion gallons per day discharged directly, .39 billion gallons per day discharged into public sewers, and .17 billion gallons per day discharged to other disposal areas. (Table 34)

Wastewaters which are discharged directly, to a public sewer, or to an aeration pond or deep well come principally from the manufacturing process. Lesser amounts are utilized for sanitary purposes, for cooling, or come from other purposes such as washing machinery, rain run-offs, etc. Before discharge, these wastewaters may be treated or may be discharged without treatment. The survey data reveal that 284 plants directly discharged 2.08 billion gallons per day of treated wastewaters, while 217 plants discharged 1.69 billion gallons per day of untreated wastewater. The direct discharge of wastewaters from sanitation facilities was reported by 148 plants which discharged 24.2 million gallons per day of treated wastewaters and 40 plants which reported a daily discharge of 4.3 million gallons per day of untreated wastewater. Plants stating

Table 33: Per Cent Volume of Wastewater Discharged by Disposal Area, by Industry, 1969

Industry	*Per Cent of Volume Discharged*		
	Directly	*Public Sewer*	*Other*
Food and kindred products	74.7%	23.0%	2.3%
Textile mill products	80.2	15.9	3.9
Paper and allied products	93.6	4.4	2.0
Chemicals and allied products	96.7	2.3	1.0
Petroleum products	98.0	1.9	.1
Rubber and plastics products	66.1	32.7	1.2
Primary metal industries	84.4	4.3	11.3
Total	92.9%	5.0%	2.1%

Table 34: Volume of Wastewater Discharged by Disposal Area, by Industry, 1969

Industry	Discharged Directly (MGD)	Public Sewer (MGD)	Discharged Other (MGD)
Food and kindred products	356.2	109.9	10.9
Textile mill products	103.5	20	5.0
Paper and allied products	1,772.1	83.6	36.6
Chemicals and allied products	3,356.7	79.5	36.1
Petroleum products	1,046.9	20.7	1.1
Rubber and plastics products	94.9	47.0	1.7
Primary metal industries	572.7	29.3	76.7
Total	7,303.0	390.5	168.2

that the discharge of cooling water was untreated outnumbered those indicating that it was treated. The volume of cooling waters discharged in treated and untreated states was almost 2.6 billion gallons per day. (Table 35)

Most of the wastewater discharged directly comes from the manufacturing process, which also is the chief source of contaminating effluents. The total volume of wastewater discharged directly from the manufacturing process in 1969 was 3.7 billion gallons per day, of which only 55.2%, or 2.1 billion gallons per day, was treated. Thus almost 45% of the prime effluent flow was discharged in an untreated state. Of total wastewater discharged from all sources, 43.1% was treated and 56.8% was discharged without treatment. These ratios indicate a greater quantity of treatment in the surveyed industries than that reported in the 1967 Census of Manufactures *Water Use in Manufacturing*, which indicated that roughly two thirds of the wastewater was discharged in an untreated state. Part of the difference may be attributable to census data for an earlier year and to the possibility that there was a greater response to the survey from plants which provided some measure of wastewater treatment and a lesser response from those who would not readily admit that they had no treatment facilities.

Characteristics of Discharged Wastewaters

The major concern in the water pollution problem is the content of the wastewater that is discharged in an untreated state into receiving waters. Of the daily direct discharge of 6.9 billion gallons of wastewater by the plants in the survey, over 4.1 billion gallons per day, or 59.1% of the total direct discharge, was released into receiving waters without treatment.

Table 35: Volume of Wastewater Discharged Directly, by Source by Industry, 1969

Industry	Manufacturing Process (MGD)		Sanitary (MGD)		Cooling (MGD)		other (MGD)	
	Treated	Untreated	Treated	Untreated	Treated	Untreated	Treated	Untreated
Food and kindred products	20.1	219.8	.8	1.4	41.2	60.9	11.0	6.2
Textile mill products	55.6	36.6	1.8	.7	.0	8.8	.0	.0
Paper and allied products	905.5	467.4	1.4	.0	19.0	300.7	1.5	76.6
Chemicals and allied products	505.6	664.8	11.2	1.1	152.0	1,461.9	1.6	242.0
Petroleum products	446.6	5.7	6.1	.0	410.5	6.8	94.2	81.6
Rubber and plastics products	2.5	37.6	.1	.3	3.6	48.9	.0	2.0
Primary metal industries	148.7	258.8	2.8	.8	18.2	124.1	.0	20.0
Total	2,084.6	1,690.7	24.2	4.3	644.5	2,012.1	108.3	428.7

The manufacturing process is the principal source of contaminants discharged in industrial wastewater and accounts for more than half of the total daily volume discharged.

The critical elements of contamination in the wastewater are many and varied. To simplify their measurement they are classified in broad categories such as BOD, the biochemical oxygen demand which measures the weight of dissolved oxygen needed by microorganisms in the water to degrade organic matter, and COD, the chemical oxygen demand which measures the equivalent oxygen needed to oxidize organic compounds to carbon dioxide and water. Other contaminants are suspended solids or particles of matter varying in size, shape and density, acid and alkaline discharges, assorted chemicals, dyes and oils, and heated liquids.

BOD Content in Discharged Wastewater

As previously noted, the manufacturing process is the principal source of BOD in the discharged wastewaters. In 1969, 363 plants reported a discharge of 4,723,625 pounds of effluent having a five-day biochemical oxygen demand from the manufacturing process. This was 93.4% of the 5,053,615 pounds per day produced from all sources. The remainder of daily output came from sanitary facilities, 0.9%; from cooling, 2.8%; and from other sources, 2.8%. (Table 36)

The total amount of over 5 million pounds per day of BOD content is most significant when viewed in terms of the amount of wastewater to which it is related. This translation in 140 plants shows an over-all BOD content of 1,653 pounds per million gallons of untreated wastewater discharged directly from the manufacturing process. (Note: The determination of the BOD, COD, and Suspended Solids content ratios per million gallons of wastewater was based upon data from plants reporting both the direct discharge of untreated wastewater from the manufacturing process and the amounts of effluent content. This accounts for the smaller number of plants and the smaller amounts of wastewater and wastewater components.) (Table 37)

COD Content of Wastewater

The 207 plants which reported the discharge of amounts of wastewaters with significant COD content poured 6.6 million pounds of effluent into receiving waters on a daily basis. More than 89% of this effluent, almost 6 million pounds per day, was produced in the manufacturing process. (Table 38)

The loads of high COD content effluent were found in the same industries that posted high BOD counts. The count in the 76 plants providing this data was 1,763,966 pounds of chemical oxygen demand effluent per 615 million gallons per day of discharged wastewater, or an average count of 2,867 pounds per million gallons. (Table 39)

Suspended Solids in the Discharged Waters

Suspended solids are a significant contribution to the pollution of the waters from plants

Table 36: Biochemical Oxygen Demand Content in Discharged Wastewater from All Sources, by Industry, 1969

Industry	*5-Day BOD Content (pounds per day)*
Food and kindred products	346,276
Textile mill products	272,414
Paper and allied products	2,604,848
Chemicals and allied products	1,341,837
Petroleum products	461,390
Rubber and plastics products	4,939
Primary metal industries	21,911
Total	5,053,615

Table 37: BOD Content per Quantity of Untreated Waters from Manufacturing Process Discharged Directly, by Industry, 1969

Industry	No.	Wastewater Discharge (MGD)	BOD Content (pounds)	Ratio (pounds per MG)
Food and kindred products	12	146.9	106,272	723
Textile mill products	14	33.0	83,822	2,537
Paper and allied products	36	437.2	1,336,878	3,057
Chemicals and allied products	58	564.7	613,402	1,086
Petroleum products	2	5.7	2,460	432
Rubber and plastics products	6	9.4	1,381	146
Primary metal industries	12	109.9	16,197	147
Total	140	1,306.8	2,160,402	1,653

Table 38: COD Content in Discharged Wastewater from All Sources, by Industry, 1969

Industry	COD Content (pounds per day)
Food and kindred products	379,264
Textile mill products	233,304
Paper and allied products	1,644,338
Chemicals and allied products	2,692,230
Petroleum products	1,606,834
Rubber and plastics products	11,859
Primary metal industries	45,495
Total	6,613,324

Table 39: COD Content per Quantity of Untreated Waters from Manufacturing Process Discharged Directly, by Industry, 1969

Industry	No.	Wastewater Discharge (MGD)	COD Content (pounds)	Ratio (pounds per MG)
Food and kindred products	4	35.5	33,989	956
Textile mill products	5	22.9	62,669	2,733
Paper and allied products	4	3.4	102,477	29,770
Chemicals and allied products	50	478.0	1,509,087	3,157
Petroleum products	2	5.7	9,935	1,755
Rubber and plastics products	2	4.7	2,265	480
Primary metals industries	9	64.8	43,544	671
Total	76	615.1	1,763,966	2,867

discharging wastes, amounting to more than 6 million pounds per day. The manufacturing process in 361 plants accounted for almost 85% of the total discharge, with 5.2 million pounds per day added to the receiving waters. The cooling process added another 11%, and most of this amount was produced in the petroleum industry. (Table 40)

Most of the industries which have produced the greatest concentration of effluents such as BOD and COD per quantity of wastewater are also those which are leaders in the production of suspended solids. The industries which would be identified as top producers of this effluent are the manufacturers of organic chemicals, pesticides, gum and wood chemical products, paper mills, pulp mills, building paper and board mills, and woolen mills. The

Table 40: Suspended Solids in Discharged Wastewaters from Manufacturing Process from All Sources, by Industry, 1969

Industry	Suspended Solids Content (pounds per day)
Food and kindred products	971,893
Textile mill products	54,392
Paper and allied products	2,215,679
Chemicals and allied products	1,487,788
Petroleum products	783,475
Rubber and plastics products	16,210
Primary metal industries	606,441
Total	6,135,878

148 plants reporting data on these discharges produced 3,977,493 pounds of suspended solids in 1.4 billion gallons of wastewater daily for an average sum of 2,655 pounds of suspended solids per million gallons discharged. (Table 41)

PH Factor in Discharged Wastewaters

The wastewaters discharged by the surveyed plants also altered the receiving waters by the discharge of acid or alkaline waste. The significant measure of this waste additive is not the cumulative result of all these outpourings, but rather the degree to which each of the production processes might affect the receiving waters by the discharge of wastewaters from the process.

The low and high ph values reported by each industry which provided at least two responses to this question are shown in Table 42.

Other Wastewater Effluents

Other wastewater components were reported by 42 plants where significant amounts of discharge were related to specialized industrial processes. A tally of amounts of effluent would require the identification of specific contaminating elements for each of the plants and a separate accounting of each variety. The questionnaire responses in many cases did not specifically identify the element or the measure of quantity. The recoverable data indicate that these discharges are made mainly in the chemicals industry (in quantity only in the manufacture of organic chemicals), in some of the petroleum refining processes, and in the production of aluminum.

The absence of meaningful data on these other wastewater components by no means indicates that they lack importance, since many of the metallic elements discharged are toxic in the right quantities. Rather, proce-

Table 41: Suspended Solids per Quantity of Untreated Waters from Manufacturing Process Discharged Directly, by Industry, 1969

Industry	No.	Wastewater Discharge (MGD)	Suspended Solids (pounds)	Ratio (pounds per MG)
Food and kindred products	12	146.9	862,152	5,869
Textile mill products	8	26.0	15,141	583
Paper and allied products	36	437.2	1,416,930	3,240
Chemicals and allied products	57	603.4	1,133,000	1,877
Petroleum products	2	5.7	3,602	636
Rubber and plastics products	8	29.6	7,357	248
Primary metal industries	25	249.0	539,311	2,165
Total	148	1,497.7	3,977,493	2,655

Table 42: PH Values of Discharged Wastewaters from Manufacturing Process, by Industry, 1969

Industry	*Low Value*	*High Value*	*Median Value*
Food and Kindred Products (20)	3.5	10.5	7.0
Meat slaughtering plants (2011)	6.0	8.0	7.0
Poultry dressing plants (2015)	–	–	–
Cheeses (2022)	–	–	–
Fluid milk (2026)	6.6	6.9	6.8
Seafoods (2031)	–	–	–
Canned fruits/vegetables (2032)	3.5	10.5	7.0
Fish (2036)	–	–	–
Frozen fruits/vegetables (2037)	6.3	8.5	7.4
Wet corn milling (2046)	5.5	8.0	6.8
Raw cane sugar (2061)	–	–	–
Cane sugar refining (2062)	7.7	10.5	9.1
Malt liquors (2082)	–	–	–
Distilled liquor (2085)	6.7	7.4	7.1
Textile Mill Products (22)	6.4	12.5	9.5
Weaving mills, cotton (2211)	6.4	12.3	9.4
Weaving mills, synthetics (2221)	7.0	8.5	7.8
Weaving, finishing mills, wool (2231)	7.0	8.5	7.8
Finishing plants, cotton (2261)	6.8	12.5	9.7
Finishing plants, synthetic (2262)	6.8	11.0	8.9
Paper and Allied Products (26)	3.4	10.0	6.7
Pulp mills (2611)	3.5	10.0	6.8
Paper mills, not building (2621)	3.4	9.5	6.5
Paperboard mills (2631)	5.0	8.8	6.9
Paper products (2641)	7.0	7.6	7.3
Building paper/board mills (2661)	4.4	8.0	6.2
Chemicals and Allied Products (28)	1.8	12.0	6.9
Alkalies/chlorine (2812)	8.0	11.6	9.8
Coal tar products (2815)	6.9	7.5	7.2
Organic chemicals (2818)	3.2	11.8	7.5
Inorganic chemicals (2819)	3.5	11.0	7.3
Plastics/resins (2821)	1.8	8.0	4.9
Synthetic rubber (2822)	2.3	8.9	5.6
Cellulosic man-made fibers (2823)	2.0	8.2	5.1
Organic fibers, noncellulosic (2824)	3.0	11.5	7.3
Pharmaceuticals (2834)	7.0	8.0	7.5
Detergents (2841)	7.0	8.1	7.6
Gum and wood chemicals (2861)	6.8	10.3	8.6
Fertilizers (2871)	2.5	8.1	5.3
Agricultural pesticides (2879)	8.0	12.0	10.0
Glue and celatin (2891)	–	–	–
Explosives (2892)	1.8	8.5	5.2
Carbon black (2895)	7.4	8.1	7.8
Petroleum and Coal Products (29)	6.1	9.7	7.9
Petroleum refining (2911)	6.1	9.7	7.9
Lubricating oils/greases (2992)	–	–	–
Rubber and Plastics Products, n.e.c. (30)	4.0	9.4	6.7
Tires/tubes (3011)	4.0	7.9	6.0
Rubber products (3069)	6.6	9.4	8.0
Plastics products (3079)	6.8	8.0	7.4
Primary Metal Industries (33)	2.3	10.5	6.4
Blast furnaces/steel mills (3312)	5.5	8.4	7.0
Steel pipe/tube (3317)	7.0	10.2	8.6
Gray iron foundries (3321)	7.0	7.9	7.5
Primary copper (3331)	2.3	8.5	5.4
Primary aluminum (3334)	3.5	10.5	7.0
Copper rolling/drawing (3351)	5.5	10.0	7.8
Aluminum rolling/drawing (3352)	6.5	8.1	7.3

Table 43: Waste Load per Production Employee, by Industry, 1969

Industry	Waste Load per Employee (pounds per day) BOD	COD	Suspended Solids
Food and kindred products	15.3	25.2	97.8
Textile mill products	4.7	7.2	1.4
Paper and allied products	40.6	145.4	35.4
Chemicals and allied products	9.8	23.8	12.8
Petroleum products	8.1	27.2	10.6
Rubber and plastics products	.2	.8	.6
Primary metal industries	.5	2.1	7.0

Table 44: Use of Public Sewer Facilities, by Industry, 1969

Industry	Number of Plants: Sewers Available	Use Sewers	Percentage of Use
Food and kindred products	86	81	94.2%
Textile mill products	61	51	83.6
Paper and allied products	69	51	73.9
Chemicals and allied products	125	105	84.0
Petroleum products	26	16	61.5
Rubber and plastics products	49	47	95.9
Primary metal industries	73	67	91.7
Total	489	418	85.4%

dures for identification and reporting of some of these elements have not been adequately established.

Temperature Change Effects of Wastewaters

The discharge of waters used for cooling and some manufacturing processes adds another influence upon the receiving waters. The great quantities of heat transferred to these waters may have inimical effects upon marine and plant life. Temperature rise in discharged water is an important characteristic of discharged industrial wastewaters which this survey tried to measure. However, the lack of adequate recoverable data and the vague and indeterminate measures relating to the effects of temperature changes inhibit any extended consideration of this type of discharge in this report.

Waste Load Measure

The amounts of effluent content per volume of wastewater are indicative of some extent of contamination of particular production processes. Another such measure might be the amount of effluent produced per production employee in particular industries. An industry might be labeled as highly pollution-prone in comparison to another if its waste load ratio per production employee were higher. By this measure, the paper industry and the food industry produce the highest ratio of waste load per employee. (Table 43)

In the paper industry and the food products industry, the manufacturers of specific products are heavy contributors of effluent content. In the paper industry pulp mills and paper mills are major producers of effluent. In the food industry manufacture of raw cane sugar is chiefly responsible for a high waste load ratio.

Use of Public Sewer Facilities

SURVEY RESPONSE indicated that a minor portion of the total volume of wastewater is deposited into public sewer systems by industrial plants as contrasted with the volume discharged directly. This may tend tc obscure the extent of use of public sewer facilities by manufacturing establishments for some of their wastewater discharge. More than 63% of the sample reported that public sewers were available for their use, and 54% of the sample used public sewers. Thus there were 489 plants with sewers available and of these 418, or 85.4% utilized the available public facility. (Table 44)

Among the 418 plants indicating use of the public sewers for some portion of their wastewater discharge, 342 also maintained their own treatment facilities. In 64 plants there was some measure of treatment given to wastewaters discharged to public sewers. As a result, 77.4 million gallons per day, or 9.8% of the total daily discharge, underwent preliminary treatment.

Among the 54.1% of the responding plants indicating use of public sewers, there is a greater percentage use in two of the industries, food and kindred products and rubber and plastics products, than in the others. However, there is no apparent tendency for a greater use because of the size of plant. This assumption might be made because of the preponderance of plants employing less than 100 persons in these industries and their customary location in urban areas. (Table 45)

The percentage of plants of the varying sizes using the public sewers is roughly comparable to the size breakdown of the total number responding according to size of plant. It should be noted that a lesser percentage of those using public sewers occurs among the plants with less than 500 employees, and a greater percentage is to be found among the plants with more than 500 employees. (Table 46)

Payment for Public Sewer Use

Financial support for the operation of a local sewer system and sewage treatment facilities is obtained by the local government by a variety of devices. The residential property owner and the commercial property owner are assessed an amount of tax relating to property size or value and this general assessment includes water supply and sewer service. More often, either water use is metered and a portion of the amount charged is earmarked for defraying the cost of providing sewer

Table 45: Public Sewer Use, by Size of Plant, by Industry, 1969

Industry	Total	Number of Plants Using Public Sewers in Plants Employing			
		20-99	100-499	500-999	1000+
Food and kindred products	81	7	31	27	16
Textile mill products	51	0	12	27	12
Paper and allied products	51	2	18	11	20
Chemicals and allied products	105	12	35	27	31
Petroleum products	16	2	5	5	4
Rubber and plastics products	47	3	11	11	22
Primary metal industries	67	4	11	20	32
Total	418	30	123	128	137

Table 46: Percentage of Public Sewer Use, by Size of Plant, by Industry, 1969

Plant Size	Plants Responding		Public Sewer Use		Per Cent Use
	Number	Per Cent	Number	Per Cent	
20-99 Employees	59	7.6%	30	7.2%	50.8%
100-499	255	33.0	123	29.4	48.2
500-999	224	28.9	128	30.6	57.1
1000 and over	235	30.4	137	32.7	58.3
Total	773	99.9%	418	99.9%	54.1%

service, or the cost of providing sewer service is levied as a surcharge upon the amount collected for water. The latter method is most commonly utilized in apportioning the liability for providing sewer service, and it is the method reported in use in most of 289 plants which acknowledged a specific cost for the use of public sewer systems. The 196 manufacturing establishments which were charged for sewer use on the basis of water use made payments to local governments or sewer districts totaling $4,059,767 in 1969.

The next most common method of apportioning the costs of the public system to industrial users is through a stated charge for annual use. Generally this charge is a flat fee charged the plant or is an amount negotiated between the plant and local government and agreed upon by contractual arrangement between the parties. The 1969 cost to 59 plants with this type of arrangement was $1,679,016.

Waste Load Charges

Considerable attention has been given to the matter of waste load charges as a means of setting local assessments upon public sewer use by industrial users. The survey data indicates that this is the least frequent method in use. A total of 34 plants of the 289 responders made their payments on the basis of waste strength or overstrength charges, and the use of this method was applicable mainly to weaving mills in the Southern Atlantic states and seven plants producing detergents. (Table 47)

It may be significant that among the survey respondents payments for the use of public sewer systems by either a waste-strength or an overstrength charge was reported primarily in three industries, the food industry, the textile mill products industry and the chemicals industry. There were no cases reported in the petroleum industry or the rubber and plastics products industry, and only one case each in the paper industry and primary metals industry.

Property Taxes for Public Sewers

The property tax assessment as a contribution to the financing of public sewer systems was utilized in 96 reported cases, some of

Table 47: Means of Payment for Use of Public Sewers, by Industry, 1969

Industry	Water Use		Waste Strength		Overstrength Charges		Other Methods	
	No.	Expenditures $	No.	Expenditures $	No.	Expenditures $	No.	Expenditures $
Food and kindred products	41	$1,012,460	7	$ 174,285	3	$ 68,460	12	$ 214,375
Textile mill products	31	386,813	10	268,984	1	18,454	7	124,000
Paper and allied products	19	213,555	1	65,990	0	–	8	817,235
Chemicals and allied products	45	1,331,208	5	506,010	6	730,664	15	413,474
Petroleum products	4	30,306	0	–	0	–	3	18,786
Rubber and plastics products	28	351,120	0	–	0	–	3	32,253
Primary metal industries	28	734,305	1	13,029	0	–	11	58,893
Total	196	$4,059,767	24	$1,028,298	10	$817,578	59	$1,679,016

Table 48: Property Tax Payments for Public Sewer Use, by Industry, 1969

Industry	Number of Plants	Amount Paid in Property Tax ($000)
Food and kindred products	17	$ 439
Textile mill products	6	178
Paper and allied products	12	2,687
Chemicals and allied products	29	891
Petroleum products	6	366
Rubber and plastics products	8	59
Primary metal industries	18	873
Total	96	$5,493

Table 49: Contributions to Capital Costs of Public Sewers, by Industry, 1969

Industry	Number of Plants	Amount Contributed ($000)
Food and kindred products	6	$ 216
Textile mill products	6	1,390
Paper and allied products	3	881
Chemicals and allied products	4	2,775
Petroleum products	2	26
Rubber and plastics products	0	–
Primary metal industries	2	163
Total	23	$5,451

Table 50: Projected Use of Public Sewer Systems, by Industry, 1969

Industry	Number Planning Use	When Planned		
		Next Year	Five Years	Later
Food and kindred products	2	2		
Textile mill products	13	11	2	
Paper and allied products	17	7	9	1
Chemicals and allied products	6	1	2	3
Petroleum products	3	2	1	
Rubber and plastics products	3	1	2	
Primary metal industries	2	—	2	–
Total	46	24	18	4

which were in addition to other means of collection for sewer use. This amounted to an industrial expenditure in 1969 of $5,493,000. Of this total, $2,666,000 was derived from taxation of 8 paper mills. (Table 48)

Contributions for Construction of Public Sewers

While assessments and charges are generally applied to the cost of maintenance and operations of public sewer systems, it is less common to have the financing of the construction of these public facilities supported by private funds. The survey recorded 23 plants which had contributed to the capital costs of constructing new public wastewater treatment facilities or to the expansion of an existing facility in cooperation with a local government or public authority. In several cases, the construction program was initially undertaken as a

joint effort of public and private interests because of the convenience and economy of having a shared facility and because of the common interests of the plant and the community. While the industrial expenditures in most cases were relatively modest, amounting to less than $50,000, there were three plants in the chemicals industry in which the contribution was close to $1 million each. All plants together contributed $5,451,000. (Table 49)

Future Public Sewer Use

Only 46 plants indicated an intention to use public sewer facilities in the future; 24 stated this would occur within a year and 18 within 5 years. (Table 50)

The projected wastewater discharge to the public sewer will be primarily from sanitary purposes or a combination of discharges from the manufacturing process and sanitary systems.

Wastewater Treatment Procedures

THE DATA PROVIDED by the respondents relating to wastewater treatment procedures and in-plant control programs indicate extensive use of pretreatment, physical and chemical, and biological treatment of wastewaters. There is little indication of treatment beyond the primary stage in any but the chemical industry.

The extensive use of public facilities for wastewater disposal as indicated in the response to this item on the survey questionnaire is more than is noted in the items dealing with public sewer use. This might indicate that many plants utilize public sewer systems for a portion of the wastewater discharge from the sanitary system, and do not identify this discharge as part of the wastewater disposal program of the plant.

Many plants have noted the use of numbers of in-plant control measures while reporting no expenditure for pollution control operations. This may be indicative of a failure in some plants to categorize such abatement programs and separately identify expenditures for this activity. It also may indicate the reporting, as pollution control programs, of control measures which are not for the abatement of pollution.

The tabulation in Table 51 shows the extent of use of each of the pollution abatement measures by principle industry category.

Table 51: Use of Water Pollution Abatement Measures, by Industry, 1969

Code		(20)	(22)	(26)	(28)	(29)	(30)	(33)	Total
	IN-PLANT CONTROL MEASURES								
	100 SERIES – ENGINEERING DESIGN CONSIDERATIONS								
101	Installation of separate drainage systems	41	7	57	141	22	19	57	344
102	Segregation and collection of specific wastes	39	2	61	114	21	17	44	298
103	Use of surface condensers in place of barometric condensers	1	0	12	23	9	0	1	46
104	Use of various water conservation measures and facilities	30	1	39	54	12	4	20	160
105	Emergency storage facilities	4	0	11	33	8	2	5	63
106	Countercurrent use of chemicals and/or washwaters	9	4	32	18	2	1	3	69
107	Use of pumps and valves with special seals to minimize leakage	6	1	15	32	3	1	3	61
109	Not defined above	0	0	2	2	1	1	0	6
	200 SERIES – PROCESS DESIGN MODIFICATIONS								
201	Use of reaction chemicals or feed stocks producing minimum waste.	0	0	9	20	2	0	3	34
202	Continuous vs. batch processes	8	1	16	37	6	3	7	78
203	Chemical regeneration	0	0	17	18	5	1	1	42
204	Downgraded use of chemicals	1	1	2	8	3	2	2	19
205	Elimination of air blowing and water washing	4	0	3	4	1	1	0	13
206	Physical separators	15	0	19	43	12	3	8	100
207	Change in design basis for chemical recovery facilities	0	0	7	21	1	0	2	31
208	Modifying operating conditions	10	2	20	36	6	1	7	82
209	Not defined above	0	0	0	4	0	2	0	6
	300 SERIES – RECOVERY AND UTILIZATION								
301	Recovery of material for reuse in process	13	2	66	87	18	3	16	205
302	Downgraded use of spent chemicals in other processes	0	0	12	19	4	0	1	36
303	Use or sale of wastes as raw material for other processes	18	0	19	37	18	2	14	108
304	Recycle or reuse of water	34	4	87	95	21	21	42	304
305	Heat recovery	17	5	44	28	9	1	2	106
309	Not defined above	0	0	0	1	0	1	0	2

Table 51 (continued)

Code		(20)	(22)	(26)	(28)	(29)	(30)	(32)	Total
	400 SERIES – LOCAL PRETREATMENT OR DISPOSAL								
401	Local separators and traps	17	1	20	65	32	7	17	159
402	Evaporation and incineration of noxious liquid wastes	2	0	13	37	4	2	9	67
403	Use of emulsion prevention chemicals	1	0	2	13	10	1	6	33
409	Not defined above	0	0	2	4	1	1	2	10
	500 SERIES – OPERATION CONTROL								
501	Automatic vs. manual process controls	20	4	27	55	11	1	10	128
502	Control of production to minimize losses	27	2	22	60	12	3	7	133
503	Administrative control of waste water discharge	7	2	15	41	8	2	23	98
504	Monitoring sewer effluents	19	1	47	89	18	5	32	211
505	Management follow-up on losses	27	1	30	56	10	3	10	137
509	Not defined above	0	0	0	0	0	2	0	2
	600 SERIES – GOOD HOUSEKEEPING								
601	Conservaton and clean-up programs	26	3	14	62	14	5	25	149
602	Publicity and educational releases	4	0	10	25	6	0	6	51
603	Employee training	26	2	13	59	10	10	17	137
609	Not defined above	0	0	0	0	0	1	0	1
	WASTEWATER DISPOSAL MEASURES								
	700 SERIES – DISCHARGE TO TREATMENT FACILITIES								
701	Private facilities	25	22	68	113	35	18	43	324
702	Public facilities	124	64	71	162	20	81	111	633
703	Cooperative facilities	2	0	4	5	0	0	2	13
704	Contract disposal	10	1	4	18	6	1	14	54
705	Transportation to more receptive environment	4	0	2	13	3	3	4	29
706	Storm water drainage	16	2	8	45	12	10	26	119
709	Not defined above	4	2	0	3	1	0	0	10
	WASTEWATER TREATMENT UNIT OPERATIONS								
	800 SERIES – PHYSICAL PRETREATMENT								
800	Equalization	0	4	7	47	5	1	8	72
801	Screening	28	8	33	25	6	2	12	114
802	Pre-aeration	3	1	5	11	8	2	5	35
803	Sedimentation	10	4	52	84	22	5	30	207
804	Flotation	11	0	10	14	10	3	6	54
805	Temperature control	5	0	3	8	3	0	7	26
806	Surface skimming (e.g. oil separation)	15	0	15	68	45	9	26	178
809	Not defined above	2	0	5	4	1	1	0	12
	810 SERIES – CHEMICAL PRETREATMENT								
810	Neutralization	4	0	6	98	19	3	30	160
811	Primary chemical coagulation	2	0	6	23	3	1	9	44
812	Chemical treatment	0	0	4	25	8	1	17	55
813	Odor control	2	0	5	13	6	0	2	28
814	Nutrient addition	5	1	14	16	6	0	1	43
819	Not defined above	0	0	0	3	0	2	0	5
	820 SERIES – BIOLOGICAL TREATMENT								
820	Stabilization basins	5	6	12	21	16	1	2	63
821	Activated sludge	8	10	14	31	14	5	6	88
822	Trickling filter	4	3	3	13	4	0	9	36
823	Aerated lagoon	4	13	21	27	21	0	2	88
824	Anerobic contact (5 to 12 hours)	0	6	4	16	2	1	2	31
825	Anerobic pond (3 to 30 days)	9	4	7	17	7	0	1	45
826	Denitrification	0	0	0	0	1	0	0	1
827	Acrobic or Anaerobic digestion of solids	8	3	5	14	8	2	13	53
829	Not defined above	0	1	0	4	3	2	0	10

(Table continued on page 38)

Table 51: Use of Water Pollution Abatement Measures, by Industry, 1969 (Continued)

		(20)	(22)	(26)	(28)	(29)	(30)	(33)	Total
	830 SERIES – SLUDGE HANDLING								
830	Thickening	1	0	23	32	2	1	13	62
831	Lagooning or drying bed	10	4	24	39	12	2	29	120
832	Centrifugation	1	0	14	4	6	0	0	25
833	Vacuum filtration	1	0	13	3	1	2	8	28
834	Dry combustion	0	0	9	1	0	0	0	10
835	Wet combustion	0	0	4	3	2	0	1	10
836	Land disposal	5	0	40	47	23	3	28	146
837	Sea disposal	0	0	0	1	0	0	1	2
839	Not defined above	2	1	2	4	1	2	1	13
	840 SERIES – TERMINAL SECONDARY TREATMENT								
840	Biological sedimentation	0	5	10	10	4	0	3	32
841	Final chemical congulation and sedimentation	0	0	4	4	0	0	4	10
842	Sand filtration	0	1	2	1	1	1	4	10
843	Diatomite filtration	0	0	0	3	0	0	0	3
844	Chlorination	5	5	9	31	3	1	17	71
849	Not defined above	0	1	1	4	1	1	0	8
	ADVANCED WASTE TREATMENT								
	850 SERIES – TEMPERATURE CHANGE PROCESSES								
850	Evaporation	1	0	8	14	0	0	0	23
851	Freezing	0	0	0	1	0	0	0	1
852	Distillation	0	0	0	3	1	0	0	4
853	Eutectic freezing	0	0	0	0	0	0	0	0
854	Wet oxidation	0	0	0	1	0	0	0	1
855	Process residue, handling and disposal	2	0	1	9	0	0	1	13
859	Not defined above	0	0	1	2	0	2	0	5
	860 SERIES – ALL OTHER								
860	Absorption	0	0	0	5	1	0	0	6
861	Electroanalysis	0	0	0	0	0	0	0	0
862	Ion exchange	0	0	0	3	0	0	0	3
863	Solvent extraction	0	0	0	5	1	0	0	6
864	Reverse osmosis	0	0	0	0	0	0	0	0
865	Foaming	0	0	1	1	0	0	0	2
865	Chemical treatment	0	0	0	4	2	1	0	7
867	Electrochemical treatment	0	0	0	0	0	0	0	0
868	Process residue, handling and disposal	0	0	1	9	2	0	4	16
869	Not defined above	0	0	1	0	1	2	0	4
	900 SERIES – TREATED WASTEWATER DISPOSAL								
901	Controlled discharge	5	2	17	42	11	4	13	94
902	Surface storage and evaporation	2	0	3	22	4	1	4	36
903	Deepwell disposal	0	0	1	15	0	0	0	16
904	Surface (spray) irrigation	5	0	7	0	0	0	1	13
905	Ocean disposal	0	0	1	7	8	0	1	17
906	Surface discharge	3	13	27	39	15	1	23	121
909	Not defined above	1	0	2	4	2	3	0	12
	Total	780	233	1,379	2,744	719	310	946	7,111

Wastewater Treatment Costs

COMPANIES MAY INCUR costs for treatment of wastewater either by operation of individual plant facilities or by the use of public systems. In the former case, that cost reflects a number of variables which are characteristic of that single specific establishment and are rarely applicable to another plant. On the other hand, the charge for the use of public facilities is generally predicated upon the amount of wastewater treated or the general treatment requirements of the wastewater. The charge for use of public systems may be entirely covered by a single assessment upon a manufacturing plant or may be based on the collection of several levies, of which some may be hidden.

The possibility of making a comparison of the costs of the treatment of wastewater may thus be limited to a consideration of the unit cost per volume of wastewater treated. The ratio of expenditure per amount of discharge is derived from reported figures on amounts spent for operation and maintenance in 1969 or, in the case of public sewer use, the amount of annual payment to a municipality, and the average daily volume of wastewater treated and discharged directly or discharged to a public sewer system. The volume of discharged water is multiplied by 300 to provide a rough estimate of the annual discharge. (Table 52)

If this unit cost of $73 per million gallons in 1969 were to be applied to the total amount of treated wastewaters from the 6,175 plants in the surveyed industries reporting in the 1967 Census of Manufactures report, *Water Use in Manufacturing*, the total annual expenditure

Table 52: Mean Cost of Treatment per Volume of Wastewater Discharged Directly, by Size of Plant, 1969

Unit Cost in Plants Employing									
20-99		100-499		500-999		1000+		20-1000+	
No.	$/MG	No.	$/MG	No.	$/MG	No.	$/MG	No.	$/MG
7	$97	73	$71	81	$86	127	$58	288	$73

Table 53: Mean Payment for Public Sewer Service per Volume of Untreated Wastewater Discharged Thereto, by Size of Plant, 1969

Unit Cost in Plants Employing									
20-99		100-499		500-999		1000+		20-1000+	
No.	$/MG	No.	$/MG	No.	$/MG	No.	$/MG	No.	$/MG
14	$116	58	$93	67	$90	70	$90	209	$91

Table 54: Mean Payment for Public Sewer Use by Property Tax, by Size of Plant, 1969

Unit Cost in Plants Employing									
20-99		100-499		500-999		1000+		20-1000+	
No.	$/MG	No.	$/MG	No.	$/MG	No.	$/MG	No.	$/MG
2	$40	19	$77	20	$132	26	$327	67	$232

for such treatment in 1968 would have been $305.4 million.

The payments to local governments for sewer service based upon some measure of quantity of water or wastewater or quality of waste load were less on a unit cost basis for the larger plants. However, the average charge for plants with more than 100 employees, $93 per million gallons, was not much above the average charge for plants with 500 or more employees – $90 per million gallons. (Table 53)

By contrast, the payments to local governments for sewer service in the form of property taxes or real property assessments were larger for the larger plants. (Table 54)

Plant Location as a Factor

THE GEOGRAPHIC LOCATION of an industrial plant gives it individual characteristics which may affect many phases of its operations. The problems attendant to water pollution abatement efforts are distinctively related to geographic location. In evaluating the effects of abatement programs consideration must be given to the differences in location, which govern the costs of construction of pollution control facilities, the availability and costs of operating manpower, the accessibility of public sewer systems, the source and quality of water resources, and the natural facilities available for disposal of plant discharges. Related also to geographic location is governmental jurisdiction, which influences cost factors and sets requirements for wastewater treatment.

In some industries, the location of plants may be governed by factors which permit location in any section of the country; in others, the availability of raw materials restricts location to particular regions. In some industries such elements as the size of plant, type of process, manpower needs, and local zoning regulations determine whether the plant will be located in rural or urban areas.

The regional distributions of capital expenditures for pollution abatement facilities and annual expenditures for operation of these facilities by the surveyed industries identify the

Table 55: Regional Distribution of Capital Expenditures for Water Pollution Abatement Facilities, by Industry, 1969

Region	Foods		Textiles		Paper		Chemicals		Petroleum		Rubber		Metals	
	No.	Exp. ($000)	No.	Exp. ($000)	No.	Exp. ($000)	No.	Exp. ($000)	No.	Exp. ($000)	No.	Exp. ($000)	No.	Exp. ($000)
New England	1	10	3	49	8	741	3	493	–	–	3	200	1	5
Middle Atlantic	4	602	–	–	13	13,065	23	7,652	6	643	1	29	13	4,841
East North Central	8	610	–	–	23	1,582	20	4,451	10	13,178	4	35	13	3,051
West North Central	5	1,350	–	–	2	424	8	633	4	286	–	–	1	91
South Atlantic	2	46	14	1,389	12	4,270	27	3,885	1	260	1	1	4	203
East South Central	2	24	–	–	7	4,216	10	2,003	1	317	–	–	4	635
West South Central	2	4	1	320	6	8,192	33	11,719	8	3,477	1	156	1	15
Mountain	3	373	–	–	1	1,029	1	75	1	68	1	8	1	87
Pacific	8	99	–	–	14	9,218	10	3,002	6	2,446	1	1	4	1,033

Table 56: Regional Distribution of Capital Expenditures for Water Pollution Abatement Facilities, by Industry, 1965-1969

Region	Foods		Textiles		Paper		Chemicals		Petroleum		Rubber		Metals	
	No.	Exp. ($000)	No.	Exp. ($000)	No.	Exp. ($000)	No.	Exp. ($000)	No.	Exp. ($000)	No.	Exp. ($000)	No.	Exp. ($000)
New England	2	120	4	91	10	2,430	5	1,568	–	–	4	335	2	43
Middle Atlantic	7	1,304	–	–	15	18,726	31	21,290	6	2,711	4	214	19	8,850
East North Central	11	3,514	–	–	29	9,574	27	15,274	12	22,831	11	7,873	21	8,923
West North Central	5	1,557	–	–	2	1,996	15	2,393	4	1,939	–	–	1	299
South Atlantic	6	322	29	5,047	13	11,117	36	24,319	2	344	1	1	5	302
East South Central	4	68	4	169	8	9,320	14	8,460	1	763	1	95	4	1,180
West South Central	4	318	1	320	8	19,025	38	31,726	11	10,678	2	159	3	264
Mountain	3	1,010	–	–	1	1,290	1	84	3	229	1	259	2	956
Pacific	11	1,370	–	–	15	30,826	10	4,850	7	13,704	–	–	4	3,434

Table 57: Regional Distribution of Annual Operating Expenditures for Water Pollution Abatement Facilities, by Industry, 1969

Region	Foods		Textiles		Paper		Chemicals		Petroleum		Rubber		Metals	
	No.	Exp. ($000)	No.	Exp. ($000)	No.	Exp. ($000)	No.	Exp. ($000)	No.	Exp. ($000)	No.	Exp. ($000)	No.	Exp. ($000)
New England	3	109	3	35	8	8,382	4	177	–	–	1	30	3	34
Middle Atlantic	5	186	–	–	11	1,850	34	9,982	6	1,456	2	35	14	1,066
East North Central	11	545	–	–	23	2,314	29	7,106	11	2,560	13	90	22	994
West North Central	6	126	–	–	1	50	15	335	4	348	1	2	1	87
South Atlantic	5	74	27	1,309	12	1,849	39	10,898	2	133	1	13	5	259
East South Central	4	56	–	–	4	395	13	4,157	1	102	1	8	3	216
West South Central	5	38	1	10	5	1,522	41	10,011	9	5,460	1	1	4	100
Mountain	3	163	–	–	1	50	2	47	1	15	1	5	1	109
Pacific	12	174	–	–	15	1,958	13	1,623	6	1,942	1	22	5	2,447

Table 58: Volume of Treated Wastewater Discharged, by Disposal Area, by Region, 1969

Region	Discharged to Receiving Waters (MGD)	Discharged to Public Sewer (MGD)	Discharged to Wells, Pools, etc. (MGD)
New England	22.9	6.3	*
Middle Atlantic	645.6	8.1	1.8
East North Central	601.8	30.0	8.3
West North Central	22.2	7.1	*
South Atlantic	471.8	3.4	20.6
East South Central	221.7	1.7	11.9
West South Central	924.0	1.7	5.0
Mountain	14.5	.6	30.8
Pacific	308.3	18.7	4.8
Total	3,232.8	77.4	83.4

*Less than .1

Table 59: Volume of Untreated Wastewater Discharged, by Disposal Area, by Region, 1969

Region	Discharged to Receiving Waters (MGD)	Discharged to Public Sewer (MGD)	Discharged to Wells, Pools, etc. (MGD)
New England	384.8	10.6	.6
Middle Atlantic	633.5	61.2	11.1
East North Central	838.6	85.0	25.7
West North Central	144.3	26.5	3.2
South Atlantic	890.4	57.5	6.2
East South Central	193.0	16.8	11.0
West South Central	718.8	7.4	15.3
Mountain	26.6	28.1	9.6
Pacific	240.1	20.0	2.2
Total	4,070.2	313.1	84.8

regions of the country in which these industries are concentrated. (Tables 55, 56 and 57)

Other factors which enter into the cost equation are the amount of wastewater which is treated by the industrial plants in particular regions and the amounts of effluent discharged which will affect the level of wastewater treatment. (Tables 58, 59 and 60)

Table 60: Effluent Content of Wastewaters Discharged Directly, by Region, 1969

Region	BOD Content (pounds)	COD Content (pounds)	Suspended Solids (pounds)
New England	242,310.0	189,902.0	434,217.0
Middle Atlantic	788,614.1	1,383,886.6	712,967.1
East North Central	573,359.9	495,729.8	602,920.1
West North Central	345,231.1	161,144.0	594,867.3
South Atlantic	924,927.3	788,912.0	692,420.7
East South Central	459,385.7	287,182.0	539,635.8
West South Central	660,202.7	2,207,981.0	1,612,812.0
Mountain	37,951.0	84,879.0	35,031.1
Pacific	1,063,333.2	740,737.0	1,024,963.0
Total	5,095,315.0	6,340,353.4	6,249,834.1

Table 61: Ratio of Five-year Capital Expenditures for Water Pollution Abatement Facilities to Gross Investment, by Region, 1969

Region	Number	Five-year Capital Expenditure ($000)	Gross Investment ($000)	Per Cent Capital Expenditure Gross Investment
New England	25	$ 4,282	$ 601,194	.7%
Middle Atlantic	73	47,678	3,659,111	1.3
East North Central	97	59,609	3,808,576	1.6
West North Central	24	6,997	787,319	.9
South Atlantic	78	30,482	3,343,179	.9
East South Atlantic	28	13,710	1,653,597	.9
West South Atlantic	49	43,775	4,811,829	.9
Mountain	9	3,604	353,225	1.0
Pacific	40	49,464	2,527,264	2.0
Total	423	$259,601	$21,545,294	1.2%

Table 62: Planned Appropriations for Water Pollution Abatement Facilities, by Region, 1970

Region	Planned Appropriations – 1970	
	Number	Amount ($000)
New England	23	$ 7,646.0
Middle Atlantic	62	31,985.0
East North Central	91	114,236.2
West North Central	24	6,104.0
South Atlantic	77	34,123.0
East South Central	28	61,464.0
West South Central	60	113,214.0
Mountain	10	5,478.0
Pacific	48	282,591.0
Total	423	$656,841.2

While measures of effort to deal with pollution problems might be expressed in terms of amounts spent for capital facilities and are related to particular industry needs, it is interesting to note that investments in capital facilities as a portion of gross investment were higher in the states in the Pacific region and the East North Central region than in the other areas. (Table 61)

Planned appropriations for the year 1970 for

capital improvements were highest in the Pacific, East North Central, and West South Central regions. (Table 62)

The influence of geographic location provides some difference in determining the expenditure to be made for providing pollution abatement. However, it is inseparable from an array of other factors which interact with and upon the location and operation of a manufacturing establishment. Therefore, no precise measure is claimed that would determine the degree of influence which location provides.

The Problem of Nonresponse

THE RATIO OF USABLE responses to the questionnaire used in the survey was 29.7% of the 2,654 questionnaires mailed to manufacturing plants in 51 selected product lines (four-digit SIC). The actual number of questionnaires returned with or without adequate data was 1,141; for a response rate of 43%. Virtually the entire response resulted from the initial request for information. Subsequent mailings produced few additional responses with data, as well as some unanswered questionnaires. The remaining 57% of unreturned questionnaires included telephone assurances from several major corporations who said they would respond but did not do so. (These telephone calls were initiated by the companies, inquiring about the due date for return of the questionnaire.)

The highest level of response was posted by the petroleum industry with a return rate of 51.5% of completed questionnaires. The lowest level of response came from the food industry. (Table 63)

It should be noted that many questionnaires were only partially completed. Some items were not answered because the data requested were not available. In other cases, items were left blank with the explanation that company

Table 63: Ratio of Return of Completed Questionnaires — Industrial Water Pollution Abatement Costs Survey

Industry	*Number of Questionnaires Sent*	*Number of Responses*	*Per Cent of Responses*
Food and Kindred Products	542	102	18.8%
Meat slaughtering	134	22	16.4
Poultry dressing	56	4	7.1
Cheeses	12	3	25.0
Fluid milk	56	18	32.1
Seafoods	17	1	5.9
Canned fruits/vegetables	83	14	16.9
Fish	22	1	4.5
Frozen fruits/vegetables	34	9	26.5
Wet corn milling	19	6	31.6
Raw cane sugar	20	2	10.0
Cane sugar refining	16	9	56.3
Malt liquors	47	8	17.0
Distilled liquor	26	5	19.2
Textile Mill Products	343	96	28.0
Cotton weaving	178	54	30.3
Synthetics weaving	60	20	33.3
Weaving, finishing, wool	60	8	13.3
Cotton finishing	33	10	30.3
Synthetic finishing	12	4	33.3
Paper and Allied Products	279	114	40.9
Pulp mills	42	17	40.5
Paper mills	133	55	41.4
Paperboard mills	53	21	39.6
Paper products	35	12	34.3
Building paper/board mills	16	9	56.3

(Table continued on page 46)

Table 63: Ratio of Return of Completed Questionnaires (continued)

Industry	Number of Questionnaires Sent	Number of Responses	Per Cent of Responses
Chemicals and Allied Products	849	260	40.1
Alkalies/chlorine	25	15	60.0
Coal tar products	21	7	33.3
Organic chemicals	91	44	48.4
Inorganic chemicals	80	30	37.5
Plastics/resins	110	30	27.3
Synthetic rubber	26	9	34.6
Cellulosic man-made fibers	27	17	63.0
Organic fibers, noncellulose	26	9	34.6
Pharmaceuticals	92	23	25.0
Detergents	32	25	78.1
Gum and wood chemicals	14	6	42.9
Fertilizers	35	16	45.7
Agricultural pesticides	13	7	53.8
Glue and gelatin	11	6	54.5
Explosives	36	10	27.8
Carbon black	10	6	60.0
Petroleum and Coal Products	99	51	51.5
Petroleum refining	85	47	55.3
Lubricating oils/greases	14	4	28.6
Rubber and Plastics Products	308	65	21.1
Tires/tubes	66	22	33.3
Rubber products	122	22	18.0
Plastics products	121	21	17.4
Primary Metal Industries	434	102	23.5
Blast furnaces/steel	178	20	11.2
Steel pipe/tube	27	10	37.0
Grey iron foundries	78	20	25.6
Primary copper	22	4	18.2
Primary aluminum	38	19	50.0
Copper rolling/drawing	45	15	33.3
Aluminum rolling/drawing	46	14	30.4
Total	2,664	790	29.7%

policy forbade the reporting of certain information. This accounts for the differing number of responses to particular items in the survey. (Table 64)

Analysis of the Nonresponse

Of the total survey sample, 352 questionnaires, or 13.3%, were returned unanswered. The largest number of these was received from the chemical industry. The highest rate of return of unanswered questionnaires, 20.3%, and the second largest number, was from the primary metals industry. (Table 65)

The principal reason given for the failure to complete the questionnaire was the assertion that the plant on which the information was requested produced little or no pollution, used limited amounts of water, and required no more in the way of treatment than a hook-up to a public sewer system. Other reasons given by significant numbers of plants included statements that the company was too busy to respond or that the cost of answering the questionnaire would require too much manpower and expense, that the information requested was confidential, or that other surveys, mainly by trade associations, were requesting information so that a response to this questionnaire would be a duplication of information

Table 64: Pattern of Responses to Items on Survey Questionnaire (Total Usable Responses – 789)

Item Number	Number of Responses
2a	754
2b	751
2c	778
3a	718
3b	714
3c	719
4a	663
4b	646
5	650
6a	687
6b	655
6c	747
6d	745
6e	744
7a	728
7b	508
7c	355
8a	612
8b	411
8c	422
8d	586
8e	420
8f	435
9	726
10a	742
10b	676
11	648
11a	600
11b	603
12a	773
12b	525
12c	316
12d	293
12e	250
12f	137
12g	124
13a	251
13b	232

provided elsewhere. In the case of 44 plants contacted, there was an outright refusal to provide information, with no other explanation supplied.

Reasons for Nonresponse	Number of Plants
Questionnaire returned blank, no reason stated	24
Information considered confidential	39
Information provided to other survey, fear of duplication	31
Too busy to respond, requires too much manpower and expense	52
Little or no pollution problem, limited water use	65
Information would not be meaningful or worthwhile	41
Outright refusal to provide information, no explanation	44
Plant sold or acquired by another company	7
New location, new company, no information available	4
Plant shutdown, no manufacturing plant at this location	37
Inadequate information provided, data unusable	8
Total	352

Of the reasons stated above, those given by 77.3% of the plants were refusals to provide any information. Prominent among these 272 refusals were those expressed by 40 plants in the steel industry, for such reasons as the confidentiality of the information or outright refusal to provide information, and those of the 39 textile mills which stated that they produced little or no pollution.

Other efforts were made with 100 major corporations to learn reasons for nonresponse. The principal reason given by 30% of the corporations for not responding was that a similar study was being undertaken by the government environmental agency and they preferred to respond to the government survey.

Table 65: Number of Survey Questionnaires Returned Unanswered, by Size of Plant, by Industry

Industry	Total	Return	Plants Employing 20-99	100-499	500 or more
Food and kindred products	24	4.4%	1	10	13
Textile mill products	49	14.3	4	7	38
Paper and allied products	39	13.9	3	6	29
Chemicals and allied products	91	14.0	8	29	54
Petroleum products	10	10.1	1	3	6
Rubber and plastics products	51	16.6	5	8	38
Primary metal industries	88	20.3	6	11	71
Total	352	13.3%	28	74	250

Data Relationships with *Water Use in Manufacturing*

THE RECENT AVAILABILITY of the data collected by the Bureau of the Census for the 1967 Census of Manufactures report, *Water Use in Manufacturing*, facilitates some comparisons of several items as they apply to the survey sample and the universe represented by the census data. The items selected for comparison include the number of establishments, the number of employees, the volume of water discharged, and the value of shipments.

Establishments

The Census report, *Water Use in Manufacturing*, lists statistical data for 6,175 establishments in the seven industrial categories included in the survey. This number of plants is less than half the total number noted in the Dun and Bradstreet listings of plants with 20 or more employees in the same industries.

The number of plants responding to the industry survey, 789, was 12.8% of the 6,175 plants which provided data for the Census report. Of the seven industrial categories covered, the chemicals industry provided the highest rate of response, and the food industry provided the lowest. (Table 66)

The relative positions of the chemicals industry and the food industry are partially attributable to their distribution among the total

Table 66: Ratio of Survey Responses to Number of Establishments Contained in Census Report, by Industry

Industry	Number of Plants		Ratio of Reponses
	Survey	Census	
Food and kindred products	102	2,345	4.3%
Textile mill products	96	684	14.0
Paper and allied products	114	619	18.4
Chemicals and allied products	259	1,125	23.0
Petroleum products	51	260	19.6
Rubber and plastics products	65	301	21.6
Primary metal industries	102	841	12.1
Total	789	6,175	12.8%

Table 67: Percentage Distribution of Total Responses, by Plants, by Industry

Industry	Percentage Distribution of Plants Responding	
	Survey	Census
Food and kindred products	12.9%	37.9%
Textile mill products	12.2	11.1
Paper and allied products	14.4	10.0
Chemicals and allied products	32.8	18.2
Petroleum products	6.5	4.2
Rubber and plastics products	8.2	4.9
Primary metal industries	12.9	13.6
Total	99.9%	99.9%

Table 68: Ratio of Number of Employees in Survey Response to Number of Employees Reported in Census of Industry

Industry	Number of Employees		Ratio
	Survey	Census	Number of Employees
Food and kindred products	71,037	633,300	11.2%
Textile mill products	94,759	413,500	22.9
Paper and allied products	91,740	267,600	34.3
Chemicals and allied products	233,123	526,800	44.3
Petroleum products	26,103	106,300	24.5
Rubber and plastics products	68,394	214,200	31.9
Primary metal industries	156,661	894,500	17.5
Total	74,817	3,056,200	24.1%

Table 69: Percentage Distribution of Number of Employees in Survey Respondents and in Census Report, by Industry

Industry	Percentage Distribution of Employees	
	Survey	Census
Food and kindred products	9.6%	20.7%
Textile mill products	12.8	13.5
Paper and allied products	12.4	8.8
Chemicals and allied products	31.4	17.2
Petroleum products	3.5	3.5
Rubber and plastics products	9.2	7.0
Primary metal industries	21.1	29.2
Total	100.0%	100.0%

Table 70: Ratio of Wastewater Discharged by Volume for the Survey Respondents and Census Establishments, by Industry

Industry	Volume of Wastewater Discharged (Billion gallons per year)*		Ratio Volume of Discharge
	Survey (1969)	Census (1967)	
Food and kindred products	119	783	15.8%
Textile mill products	32	136	23.5
Paper and allied products	662	2,078	31.8
Chemicals and allied products	1,042	4,175	24.9
Petroleum products	321	1,317	24.3
Rubber and plastics products	50	128	39.0
Primary metal industries	204	4,696	4.3
Total	2,430	13,183	18.2%

responses in the survey and the Census report. In the industry survey, the chemicals industry was the largest percentage component of the total responses. In the Census report, the food industry occupied that position. (Table 67)

Employees

The number of employees in the plants responding to the industry survey was 24.3% of the number of employees noted in the Census report. This larger ratio, as compared with 12.8% of the number of establishments, indicates that the response to the survey was made by the larger establishments. In this category, as in the number of establishments, the largest ratio was posted by the chemicals industry and the smallest by the food industry. (Tables 68 and 69)

Volume of Wastewater Discharged

The volume of wastewater discharged by the establishments in the seven industrial categories

Table 71: Percentage Distribution of Wastewater Volume Discharged, by Industry

Industry	Percentage Distribution of Discharged Volume	
	Survey	Census
Food and kindred products	4.9%	5.7%
Textile mill products	1.3	1.0
Paper and allied products	27.2	15.8
Chemicals and allied products	42.9	31.7
Petroleum products	13.2	9.2
Rubber and plastics products	2.0	1.0
Primary metal industries	8.4	35.6
Total	99.9%	100.0%

Table 72: Ratio of Value of Shipments Reported to the Census Posted by Respondents to the Industry Survey, by Industry

Industry	Value of Shipments Reported		Ratio Value of Shipment
	Survey (1969) (in millions)	Census (1968) (in millions)	
Food and kindred products	$ 4,940	$ 38,685	12.8%
Textile mill products	2,009	9,236	21.8
Paper and allied products	3,289	9,996	32.9
Chemicals and allied products	8,084	27,635	29.3
Petroleum products	2,956	19,743	15.0
Rubber and plastics products	1,907	6,334	30.1
Primary metal industries	6,120	34,803	17.6
Total	$29,305	$146,432	20.0%

Table 73: Percentage Distribution of Value of Shipments Reported in the Survey and in the Census, by Industry

Industry	Ratio of Industry Amount to Seven Industry Total			
	Survey (1969)	Rank	Census (1968)	Rank
Food and kindred products	16.9%	3	26.4%	1
Textile mill products	6.9	6	6.3	6
Paper and allied products	11.2	4	6.8	5
Chemicals and allied products	27.6	1	18.9	3
Petroleum products	10.1	5	13.5	4
Rubber and plastics products	6.5	7	4.3	7
Primary metal industries	20.8	2	23.8	2
Total	100.0%		100.0%	

in the Census report was 13,183 billion gallons per year for 1968. The survey respondents reported a discharge for 1969 of 2,430 billion gallons, or 18.2% of the Census total. (Table 70)

Of the 13,183 billion gallons discharged by the 6,175 establishments reporting for the Census, 12,117 billion gallons, or 91.9%, were discharged directly to receiving waters, and 715 billion gallons, or 5.4% were discharged to public sewers. This compares with a finding in the survey of 92.9% discharged directly to receiving waters and 5.0% discharged to public sewers. (Table 71)

If the percentages attributed to the primary metals industries were excepted, because of the low response from these industries in the industry survey, the ranking of the percentage distribution would be the same for the first four of the remaining six industry categories.

Table 74: 1969 Survey Data as a Percentage of 1968 Census Data for Selected Items, by Industry

Industry	Number of Establishments	Number of Employees	Volume of Wastewater Discharged	Annual Value of Shipments
Food and kindred products	4.3%	11.2%	15.8%	12.8%
Textile mill products	14.0	22.9	23.5	21.8
Paper and allied products	18.4	34.2	31.8	32.9
Chemicals and allied products	23.0	44.2	24.9	29.3
Petroleum products	19.6	24.5	26.3	15.0
Rubber and plastics products	21.5	31.9	39.0	30.1
Primary metal industries	12.1	17.5	4.3	17.6
Total	12.8%	24.3%	18.2%	20.0%

Value of Shipments

The value of shipments for 1969 reported by the plants responding to the industry survey was $29.3 billion. This amount was 20.0% of the $146.5 billion produced in 1968 by the plants reporting to the Bureau of the Census. The industries which posted the high ratios of product value were the paper industry and the chemicals industry. The industry which posted the lowest ratio was the food industry. (Table 72)

The percentage distribution for the value of shipments figures shows some similarity among those industries which reported the low figures, and again repeats the placement of the chemicals industry at the top of the survey ratios and the food industry at the top of the ratio of Census amounts. (Table 73)

Summary View

On an over-all view, the industry survey represents data reflective of 12.8% of the establishments included in the Census report in the specified seven industry categories, which further represents 24.3% of the employment in these establishments, 18.2% of the water discharged by these establishments, and 20.0% of the value of shipments reported by these establishments. These comparisons are made for 1969 figures reported in the industry survey and 1968 figures reported in the Census document. (Table 74)

In terms of other more specific comparisons, the volume of wastewater discharged directly reported in the industry survey as a portion of the total volume of discharged wastewater was 92.9%, as compared with 91.9% reported for the same industries in the Census report. Similarly, the percentage of volume of wastewater discharged to public sewers as reported in the industry survey was 5.0%, as compared to a percentage in the Census of 5.4%.

Moreover, the amount of expenditure for annual operation and maintenance of water pollution abatement facilities which could be attributable to the 6,175 establishments in the Census document, if derived by applying the mean cost of treatment per volume of wastewater discharged directly in the survey, $73 per million gallons, to the total volume of treated wastewater reported in the Census, would amount to an annual expenditure of $304.1 million. If derived by application of the ratio of annual operating expenditures to value of shipments developed in the survey, .202%, to the 1968 total of value of shipments reported in the Census document, the computed annual operating expenditure for the 6,175 establishments would total $295.7 million. The gap between the amounts computed by these separate measures would be $8.4 million, or a 2.8% difference.

APPENDIX A
Survey Questionnaire
Tabular Sources

THE NATIONAL INDUSTRIAL CONFERENCE BOARD
INCORPORATED
845 THIRD AVENUE, NEW YORK, N. Y. 10022

Budget Bureau No. 42-S89006
Approval Expires Dec. 31, 1970

SURVEY QUESTIONNAIRE

STUDY OF WATER POLLUTION ABATEMENT COSTS

General Directions

A separate report should be prepared for each plant. It is necessary to know these data for each plant so as to relate the production and financial data to the wastewater abatement cost data when making cost burden and incentive analyses.

A plant is defined as the total facilities and operations at one location. Whether a few or many products are made at this location, it still should be considered one plant. This excludes facilities restricted entirely to such operations as warehousing and storage, research and development, and sales offices.

In the preparation of this survey questionnaire, care was taken to request information, wherever possible, in terms identical to those utilized in various reports to the Bureau of the Census. This was done to provide a recognized standard for some of the information requested and to permit the respondent to provide information similar to that which has been compiled for other reports.

Please report for *calendar year 1969* unless otherwise specified. If this is not possible, specify the reporting period for which data are provided. _____

Please return the completed form to *Leonard Lund, National Industrial Conference Board, 845 Third Avenue, New York, New York 10022.* Do not indicate your name or company on this form. The Code Number on this page identifies you to The Conference Board. No personal or corporate identification will appear in any report based on this survey without your explicit authorization.

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ITEM 1. PRODUCT INFORMATION

(a) Principal product(s) of this plant _____

_____

_____

(Describe by using categories defined in the Standard Industrial Classification Manual, e.g., "Chemicals and Allied Products," "Industrial Gases," "Food and Kindred Products, Fluid Milk," "Transportation Equipment, Motor Vehicles," or similar descriptive phrases.)

(b) Standard Industrial Classification Code(s). (If known)

_____.

(4 digit code(s))

ITEM 2. NUMBER OF EMPLOYEES

(a) **Production Workers**—Workers (up through the working foreman level) engaged in fabricating, processing, assembling, inspecting, receiving, packing, warehousing, shipping (but not delivering), maintenance, repair, janitorial, watchman services, product development, auxiliary production for plant's own use (e.g., powerplant), recordkeeping, and other closely associated services. Exclude proprietors and partners.

Number of production employees during typical month _____

(b) **All Other Employees**—Nonproduction personnel, including those engaged in the following activities: supervision above working foreman level, sales (including driver salesmen), sales delivery (truck drivers and helpers), advertising, credit, collection, installation and servicing of own products, clerical and routine office functions, executive, purchasing, finance, legal, personnel (incl. cafeteria, etc.), professional and technical. Exclude proprietors and partners.

Number of all other employees during typical month _____

(c) Total number of employees (sum of lines a and b) _____

ITEM 3. PAYROLLS

Enter the total (before deductions) of wages, salaries, bonuses, commissions, and other remunerations paid in 1969 to "Production Workers," and "All Other Employees," as defined in Item 2 above.

a) Production workers' wages $ _____

b) All other employees' salaries and wages $ _____

c) TOTAL PAYROLL (Sum of Lines a and b) $ _____

56

ITEM 4. PRODUCTION COSTS

(a) What were the costs of materials, fuels, electricity and contract work put into production in 1969?
$_____

Note: The figures reported should represent the total cost of materials, supplies, semi-finished goods, fuels, etc., actually consumed or put into production as in reports to the Census Bureau.

If your records do not show the amounts actually consumed or put into production, the reported figures may be derived from purchase and other records.

(b) What were the depreciation charges in 1969? $_____

ITEM 5. VALUE OF SHIPMENTS

What was the value of products shipped in 1969? $_____

ITEM 6. VALUE AND AGE OF FIXED ASSETS

In order to obtain an estimate of the value and age of the plant and equipment, please answer the following:

(a) What was the gross investment in plant and equipment as of December 31, 1969? $_____

(b) What was the book value (gross investment minus straight line depreciation) of plant and equipment?
$_____

(c) Was the plant built within the last five years? Yes ☐ No ☐

(d) Was the capacity of this plant expanded significantly (more than 50%) within the past five years? Yes ☐ No ☐

(e) Was more than 50% of the production equipment in this plant installed or significantly modified within the past five years? Yes ☐ No ☐

ITEM 7. CAPITAL EXPENDITURES FOR ABATEMENT FACILITIES

(a) Please estimate the capital expenditures for the purpose of water pollution abatement at this plant for each year of the period 1965-1969. Report separately the amounts spent for *replacement and modernization of existing facilities* and the amounts spent for *new facilities including expansion.*

Note: Report only those expenditures made for the purpose of pollution abatement. If improvements have been made in the production process which provide an incidental benefit in the abatement of pollution *do not* include the expenditure for that improvement.

Year	Replacement and modernization of existing facilities	New facilities including expansion	Total Expenditure
1965	$_____	$_____	$_____
1966	$_____	$_____	$_____
1967	$_____	$_____	$_____
1968	$_____	$_____	$_____
1969	$_____	$_____	$_____
Total (1965-1969)	$_____	$_____	$_____

(b) For which of the following types of water pollution abatement measures were most of the capital expenditures made at this plant during 1965-1969? (If the investment falls primarily in one category, check that box; if it is divided among several, check all appropriate boxes for which expenditures were more than 20% of total.)

Manufacturing changes to reduce water pollution . . . . . ☐

Wastewater treatment . . . . . ☐

Water cooling (See Note below) . . . . . ☐

Other (please specify) _____ . . . . . ☐

Note: Water cooling done primarily to reduce the quantity of intake water needed for production purposes is not considered pollution abatement. Cooling for the purpose of preventing the discharge of heated water to a river, lake, stream, or estuary, is considered pollution abatement.

(c) If this plant currently has no water pollution abatement facilities, does it plan to build any? Yes ☐ No ☐
If yes, when? Next year ☐ In five years ☐ After that ☐

ITEM 8. PLANNED CAPITAL APPROPRIATIONS FOR POLLUTION ABATEMENT FACILITIES

Please report:

(a) Capital appropriation for abatement facilities for 1970 $_____

(b) Number of years in which to be spent _____.

(c) For which type of measures: (see 7b)
- Manufacturing process changes ☐
- Wastewater treatment ☐
- Water cooling (see Note 7b) ☐
- Other (specify) ☐

_____

Please report:

(d) Total future capital requirements, including 1970, to meet present water quality standards $_____

(e) Number of years in which to be spent _____

(f) For which type of measures: (see 7b)
- Manufacturing process changes ☐
- Wastewater treatment ☐
- Water cooling (see Note 7b) ☐
- Other (specify) ☐

_____

ITEM 9. WATER POLLUTION ABATEMENT MEASURES

Using the accompanying chart of abatement measures (Attachment I), please indicate the code numbers of those measures already in place in this plant, and in the order in which applied. In the event that wastewaters from more than one source within the plant are combined for treatment in a common facility (e.g., process and sanitary wastewaters) please indicate this by showing which sources are combined.

Wastewater Source	Abatement Measure Code Numbers
Manufacturing process	
Sanitary	
Cooling (see Note 7b)	
Other – (please specify)	
_____	
_____	

ITEM 10. VOLUME AND CHARACTERISTICS OF DISCHARGED WASTEWATERS

(a) Average daily volume of discharged wastewater by source:
(Report typical discharges in million gallons per operating day.)

Source	Discharged Directly		Discharged to Public Sewer		Other manner of disposal (specify)____	
	Treated	Untreated	Treated	Untreated	Treated	Untreated
Manufacturing Process						
Sanitary						
Cooling (see Note 7b)						
Other (specify) _____						
Total	mgd	mgd	mgd	mgd	mgd	mgd

(b) Wastewater constituents discharged directly by source: (Report in pounds per day, pH units, degrees Fahrenheit)

Source	Biochemical Oxygen Demand (Five Day)	Chemical Oxygen Demand	Suspended Solids	pH	Temperature Rise	Other (Please specify)
Manufacturing Process						
Sanitary						
Cooling (see Note 7b)						
Other (Please specify) _____						
TOTAL						

(c) Please describe any seasonal aspects of production that may affect the quantity of wastewater discharged.

_____

ITEM 11. EXPENDITURES FOR OPERATION AND MAINTENANCE OF WATER POLLUTION ABATEMENT FACILITIES

(a) Annual expenditures for operating and maintaining existing water pollution abatement facilities.
1968 $_____ 1969 $_____.

(b) Estimate of annual expenditures for operating and maintaining abatement facilities upon completion of construction noted in ITEM 8d. $_____.

(c) Estimate of number of employees engaged in operating and maintaining pollution abatement facilities in 1969._____
(Equivalent full-time manpower)

ITEM 12. USE OF PUBLIC SEWER SYSTEMS

(a) Is there a public sewer system available for use by this plant? Yes ☐ No ☐

(b) If yes, does this plant discharge wastewater into public sewer? Yes ☐ No ☐

If answer to (b) is Yes:

(c) What was annual payment by this plant to municipality or other authority for sewer service, excluding property tax? $_____

(d) What was basis of payment? (Check all relevant boxes)

- Water use ☐
- Waste strength ☐
- Over-strength surcharges ☐
- Other (Specify) ☐

_____

If answer to (b) is No:

(e) If plant does not, does this plant plan to use public sewer in the future? Yes ☐ No ☐

(f) If yes, when? Next year? ☐
In five years? ☐
Later? ☐

(g) If yes, what kind of wastewater will be discharged? Please check.

- All wastewater ☐
- Manufacturing process only ☐
- Sanitary only ☐
- Manufacturing process and sanitary ☐
- Cooling (see Note 7b) ☐
- Other (specify) ☐

_____

ITEM 13. OTHER CONTRIBUTIONS TO FINANCING OF PUBLIC SEWER SYSTEM

(a) What payments were made to a local government unit for sewer service in the form of property taxes or assessments? $_____.

(b) What, if anything, has been contributed to the capital cost of constructing a new public wastewater treatment facility or expanding of an existing facility in cooperation with a municipality or other public authority in addition to amounts reported above? $_____

ITEM 14. GENERAL OBSERVATIONS

We would appreciate any observations which you would care to make regarding features of the operation or location of this plant that you feel would make for special problems in wastewater treatment; and any comment you may wish to make concerning this questionnaire or the use of the data provided. If any costs have been incurred or are anticipated because of plant relocation or process change primarily influenced by water pollution abatement requirements, please describe their nature and costs in this section.

ITEM 15.

Name and title of person to be contacted in the event that additional correspondence or information may be required.

Name_____

Title _____

Sources of Tabular Data

Table Number	*Questionnaire Items**
1, 2, 3	7a
4, 5	6a, 7a
6, 7, 8	2c, 7a
9, 10	2c, 6a, 7a
11	2c, 7a
12	7a
13, 14, 15	2c, 11a
16	11a, 11c
17	2a, 2c, 11a
18	3c, 11a
19	2a, 2c, 11a
20	2c, 6a, 11a
21	2c, 6b, 11a
22	8a
23	8d
24	8e
25	4a, 11a
26	2c, 4a, 11a
27	5, 7a
28, 29	2c, 5, 11a
30	4a, 4b, 5, 7a
31	2c, 4a, 4b, 5, 11a
32	2c, 3c, 4a, 4b, 5, 11a
33, 34, 35	10a
36	10b
37	10a, 10b
38	10b
39	10a, 10b
40	10b
41	10a, 10b
42	10b
43	2a, 10b
44	12a, 12b
45	2c, 12b
46	2c, 12a, 12b
47	12c, 12d
48	13a
49	13b
50	12e, 12f
51	9
52	2c, 10a, 11a
53	2c, 10a, 12c
54	2c, 10a, 13a
55, 56	†, 7a

Table number	*Questionnaire Items**
57	†, 11a
58, 59	†, 10a
60	†, 10b
61	†, 6a, 7a
62	†, 8a
63, 64, 65	N.A.
66, 67	1, B.C. Table 2
68, 69	2c, B.C. Table 2
70, 71	10a, B.C. Table 1b
72, 73	5, B.C. Table 3
74	1, 2c, 5, 10a, B.C. 1b, B.C. 2, B.C. 3

Appendix Table Number	*Questionnaire Items*
I, II	2c, 7a
III	6a, 7a
IV	6b, 7a
V	6a, 6d, 7a
VI	6a, 6c, 6d, 6e, 7a
VII	6a, 6c, 7a
VIII	4a, 4b, 5, 7a
IX	7a, 7b
X	2c, 6a, 7a
XI	2c, 6b, 7a
XII	2c, 11a
XIII	2c, 6a, 11a
XIV	2c, 6b, 11a
XV	2c, 3c, 11a
XVI	2c, 2a, 11a
XVII	2c, 5, 11a
XVIII	2c, 4a, 11a
XIX	2c, 3c, 4a, 4b, 5, 11a
XX	11a, 11c
XXI	2c, 10a, 11a
XXII	2c, 12b
XXIII	12d
XXIV	13a
XXV	2c, 10a, 12c
XXVI	2c, 10a, 13a
XXVII	10a
XXVIII, XXIX, XXX, XXXI	10b
XXXII, XXXIII, XXXIV	10a, 10b
XXXV, XXXVI, XXXVII	2a, 10b

* All tables broken down by industry also utilize data in Item 1.
† Regional breakdown derived from questionnaire code number.
B.C. Refers to 1967 Census of Manufactures,

APPENDIX B
Capital Expenditures Cost Data

I. Capital Expenditures, by Size of Plant, by Industry, 1965-1969

II. Total Capital Expenditures, by Size of Plant, by Industry, 1969

III. Ratio of 5-year Capital Expenditures to Gross Investment, by Industry, 1969

IV. Ratio of 5-year Capital Expenditures to Book Value, by Industry

V. Ratio of 5-year Capital Expenditures to Gross Investment in Plants with No Change in Capacity or Other Major Replacement from 1965-1969

VI. Ratio of 5-year Capital Expenditures to Gross Investment in New Plants or in Plants with a Major Expansion or Replacement from 1965-1969

VII. Ratio of 5-year Capital Expenditures to Gross Investment in Plants Built Within Past 5 Years, by Industry

VIII. Ratio of 1969 Capital Expenditures to Value Added by Manufacture, by Industry

IX. Number Making Capital Expenditures, by Type of Abatement Facilities, by Industry, 1969

X. 5-year Capital Expenditures as a Per Cent of Gross Investment, by Size of Plant, by Industry

XI. 5-year Capital Expenditures as a Per Cent of Book Value, by Size of Plant, by Industry

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I: Capital Expenditures, by Size of Plant, by Industry, 1985-1989

Industry	1985-1989 Capital Expenditures ($000)			
	20-99	100-499	500-999	1000+
Food and Kindred Products	$ 90	$ 1,419	$ 4,182	$ 2,847
Meat slaughtering	8	119	1,139	339
Poultry dressing	–	257	1	–
Cheeses	60	–	–	–
Fluid milk	–	14	–	91
Seafoods	–	–	–	59
Canned fruits/vegetables	28	976	932	–
Fish	–	–	34	–
Frozen fruits/vegetables	–	30	91	1,461
Wet corn milling	–	430	1,967	885
Raw cane sugar	–	3	10	–
Cane sugar refining	3	–	362	–
Malt liquors	–	–	10	199
Distilled liquor	–	1	–	–
Textile Mill Products	–	490	1,489	2,946
Cotton weaving	–	121	676	2,966
Synthetics weaving	–	47	172	612
Weaving, finishing, wool	–	320	80	170
Cotton finishing	–	2	162	–
Synthetic finishing	–	–	617	–
Paper and Allied Products	291	28,538	25,571	46,699
Pulp mills	–	11,388	8,464	4,190
Paper mills	10	14,440	9,481	36,833
Paperboard mills	281	1,182	6,236	2,241
Paper products	–	2,108	70	1,639
Building paper/board mills	–	440	226	1,896
Chemicals and Allied Products	765	14,227	24,980	66,662
Alkalies/chlorine	10	1,714	1,166	3,830
Coal tar products	197	900	–	1,340
Organic chemicals	–	2,748	8,859	25,286
Inorganic chemicals	319	5,047	4,107	11,034
Plastics/resins	60	199	1,268	6,720
Synthetic rubber	–	–	1,807	3,991
Cellulosic man-made fibers	9	2,168	–	3,899
Organic fibers, noncellulose	–	216	780	1,491
Pharmaceuticals	–	232	1,016	2,283
Detergents	–	189	3,982	3,916
Gum and wood chemicals	–	221	–	19
Fertilizers	4	711	530	3,994
Agricultural pesticides	87	140	748	–
Glue and gelatin	10	9	–	1,396
Explosives	70	97	31	4,226
Carbon black	–	21	–	–
Petroleum and Coal Products	42	10,840	15,648	15,782
Petroleum refining	29	10,831	15,648	15,782
Lubricating oils/greases	13	7	–	–
Rubber and Plastics Products	209	198	398	6,236
Tires/tubes	156	–	91	489
Rubber products	53	1	280	370
Plastics products	–	195	9	1,469
Primary Metal Industries	14	2,377	2,476	10,219
Blast furnaces/steel	–	23	762	1,197
Steel pipe/tube	–	–	419	885
Gray iron foundries	–	64	94	2,536
Primary copper	–	–	88	83
Primary aluminum	–	1,039	1,019	1,894
Copper rolling/drawing	4	216	43	2,166
Aluminum rolling/drawing	10	1,043	94	913
Total	1,420	61,011	74,837	145,618

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II: Total Capital Expenditures, by Size of Plant, by Industry, 1969

Industry	1969 Total Capital Expenditures ($000) 20-99	100-499	500-999	1000+
Food and Kindred Products	$ 30	$ 483	$ 1,242	$ 468
Meat slaughtering	3	78	3	53
Poultry dressing	–	45	–	–
Cheeses	24	–	–	–
Fluid milk	–	14	–	18
Seafoods	–	–	–	–
Canned fruits/vegetables	1	52	62	–
Fish	–	–	–	–
Frozen fruits/vegetables	–	–	21	47
Wet corn milling	–	293	921	350
Raw cane sugar	–	1	5	–
Cane sugar refining	2	–	230	–
Malt liquors	–	–	–	–
Distilled liquor	–	–	–	–
Textile Mill Products	–	407	483	868
Cotton weaving	–	75	–	865
Synthetics weaving	–	12	164	3
Weaving, finishing, wool	–	320	13	–
Cotton finishing	–	–	69	–
Synthetic finishing	–	–	237	–
Paper and Allied Products	115	10,034	6,620	25,879
Pulp mills	–	4,551	1,815	3,706
Paper mills	10	4,019	3,943	19,263
Paperboard mills	105	276	537	1,010
Paper products	–	1,068	–	400
Building paper/board mills	–	120	325	1,500
Chemicals and Allied Products	100	5,797	9,451	18,162
Alkalies/chlorine	–	473	508	1,148
Coal tar products	–	2	–	2,075
Organic chemicals	–	757	3,290	7,658
Inorganic chemicals	60	2,121	868	365
Plastics/resins	–	75	1,102	1,083
Synthetic rubber	–	–	503	1,794
Cellulosic man-made fibers	5	1,850	–	370
Organic fibers, noncellulose	–	200	2	949
Pharmaceuticals	–	13	846	464
Detergents	–	61	1,925	1,666
Gum and wood chemicals	–	201	–	19
Fertilizers	–	7	100	–
Agricultural pesticides	5	15	300	–
Glue and gelatin	10	3	–	46
Explosives	20	17	7	525
Carbon black	–	2	–	–
Petroleum and Coal Products	–	11,542	3,944	2,928
Petroleum refining	–	11,535	3,944	2,928
Lubricating oils/greases	–	7	–	–
Rubber and Plastics Products	156	39	4	231
Tires/tubes	156	–	–	76
Rubber products	–	–	3	155
Plastics products	–	39	1	–
Primary Metal Industries	4	163	575	9,219
Blast furnaces/steel	–	–	211	2,726
Steel pipe/tube	–	–	124	995
Gray iron foundries	–	–	29	1,263
Primary copper	–	–	27	87
Primary aluminum	–	61	117	639
Copper rolling/drawing	4	100	–	3,395
Aluminum rolling/drawing	–	2	67	114
Total	405	28,465	22,319	57,755

III: Ratio of 5-Year Capital Expenditures to Gross Investment, by Industry, 1969

Industry	Number of Plants	Capital Expenditures as Per Cent of Investment
Food and Kindred Products	47	1.1
Meat slaughtering	13	1.7
Poultry dressing	4	2.5
Cheeses	2	3.6
Fluid milk	–	–
Seafoods	1	.3
Canned fruits/vegetables	7	2.2
Fish	1	1.0
Frozen fruits/vegetables	7	1.6
Wet corn milling	4	.9
Raw cane sugar	2	.1
Cane sugar refining	3	.6
Malt liquors	2	.1
Distilled liquor	1	.05
Textile Mill Products	35	.8
Cotton weaving	18	.7
Synthetics weaving	5	.5
Weaving, finishing, wool	5	1.1
Cotton finishing	5	.5
Synthetic finishing	2	2.5
Paper and Allied Products	93	2.3
Pulp mills	16	2.9
Paper mills	45	2.5
Paperboard mills	21	1.3
Paper products	8	1.4
Building paper/board	3	1.3
Chemicals and Allied Products	140	1.0
Alkalies/chlorine	11	.7
Coal tar products	2	2.3
Organic chemicals	28	.8
Inorganic chemicals	18	1.8
Plastics/resins	13	.7
Synthetic rubber	5	.7
Cellulosic man-made fibers	10	1.2
Organic fibers, noncellulose	4	.7
Pharmaceuticals	10	1.2
Detergents	17	1.2
Gum and wood chemicals	3	.4
Fertilizers	4	1.5
Agricultural pesticides	3	4.5
Glue and gelatin	4	.8
Explosives	6	1.0
Carbon black	2	.1
Petroleum and Coal Products	27	1.4
Petroleum refining	25	1.4
Lubricating oils/greases	2	.3
Rubber and Plastics Products	22	1.5
Tires/tubes	9	.1
Rubber products	6	.6
Plastics products	7	12.0
Primary Metal Industries	58	.6
Blast furnaces/steel	12	.5
Steel pipe/tube	5	.9
Gray iron foundries	10	.9
Primary copper	3	.2
Primary aluminum	11	.3
Copper rolling/drawing	9	2.2
Aluminum rolling/drawing	8	.4
Total	422	1.2

IV: Ratio of 5-year Total Capital Expenditures to Book Value, by Industry

Industry	*Number of Plants*	*Per Cent Total Capital Expenditures to Book Value*
Food and Kindred Products	48	2.0
Meat slaughtering	13	4.0
Poultry dressing	4	7.3
Cheeses	2	9.9
Fluid milk	2	.3
Seafoods	1	.6
Canned fruits/vegetables	6	4.1
Fish	1	1.9
Frozen fruits/vegetables	7	2.8
Wet corn milling	4	1.8
Raw cane sugar	2	.2
Cane sugar refining	3	.9
Malt liquors	2	.2
Distilled liquor	1	.05
Textile Mill Products	27	1.2
Cotton weaving	17	1.4
Synthetics weaving	3	.5
Weaving, finishing, wool	1	1.9
Cotton finishing	5	1.5
Synthetic finishing	1	.4
Paper and Allied Products	95	3.9
Pulp mills	15	4.0
Paper mills	48	4.6
Paperboard mills	21	2.3
Paper products	8	2.7
Building paper/board mills	3	2.0
Chemicals and Allied Products	135	2.1
Alkalies/chlorine	11	2.0
Coal tar products	2	5.0
Organic chemicals	28	1.7
Inorganic chemicals	15	4.6
Plastic/resins	11	1.6
Synthetic rubber	5	2.1
Cellulosic man-made fibers	9	2.2
Organic fibers, noncellulose	4	1.1
Pharmaceuticals	10	1.9
Detergents	17	2.6
Gum and wood chemicals	3	.8
Fertilizers	5	2.3
Agricultural pesticides	4	6.7
Glue and gelatin	4	2.2
Explosives	6	1.3
Carbon black	1	.3
Petroleum and Coal Products	27	3.2
Petroleum refining	25	3.2
Lubricating oils/greases	2	.7
Rubber and Plastics Products	22	2.8
Tires/tubes	9	.3
Rubber products	6	1.1
Plastics products	7	21.4
Primary Metal Industries	58	1.2
Blast furnaces/steel	12	1.2
Steel pipe/tube	5	1.9
Gray iron foundries	10	2.0
Primary copper	3	.3
Primary aluminum	11	.6
Copper rolling/drawing	9	4.1
Aluminum rolling/drawing	8	.8
Total	412	2.4

V: Ratio of 5-year Total Capital Expenditures to Gross Investment in Plants with No Change in Capacity or Other Major Replacement from 1965-1969

Industry	*Number of Plants*	Total Capital Expenditures as Per Cent of Gross Investment
Food and Kindred Products	38	.8
Meat slaughtering	10	1.5
Poultry dressing	4	2.5
Cheeses	2	3.6
Fluid milk	–	–
Seafoods	1	.3
Canned fruits/vegetables	5	2.1
Fish	1	1.0
Frozen fruits/vegetables	5	2.3
Wet corn milling	2	.5
Raw cane sugar	2	.1
Cane sugar refining	3	.6
Malt liquors	2	.1
Distilled liquor	1	.*
Textile Mill Products	31	.7
Cotton weaving	16	.7
Synthetics weaving	4	.6
Weaving, finishing, wool	4	.5
Cotton finishing	5	.5
Synthetic finishing	2	2.5
Paper and Allied Products	73	2.1
Pulp mills	11	2.5
Paper mills	39	2.3
Paperboard mills	17	.9
Paper products	5	1.3
Building paper/board mills	1	1.8
Chemicals and Allied Products	99	1.0
Alkalies/chlorine	7	.8
Coal tar products	1	2.3
Organic chemicals	18	.8
Inorganic chemicals	13	1.8
Plastics/resins	8	.9
Synthetic rubber	4	.7
Cellulosic man-made	7	.8
Organic fibers, noncellulose	–	–
Pharmaceuticals	7	1.0
Detergents	17	1.2
Gum and wood chemicals	2	.2
Fertilizers	3	.6
Agricultural pesticides	3	4.5
Glue and gelatin	4	.8
Explosives	5	1.0
Carbon black	–	–
Petroleum and Coal Products	20	1.6
Petroleum refining	19	1.6
Lubricating oils/greases	1	.1
Rubber and Plastics Products	15	1.6
Tires/tubes	7	.1
Rubber products	4	.4
Plastics products	4	14.7
Primary Metal Industries	48	.4
Blast furnaces/steel	10	.5
Steel pipe/tube	5	.9
Gray iron foundries	10	.9
Primary copper	3	.2
Primary aluminum	8	.1
Copper rolling/drawing	7	.3
Aluminum rolling/drawing	5	.2
Total	324	1.2

*Less than .05

VI: Ratio of 5-year Total Capital Expenditures to Gross Investment in New Plants or in Plants with Major Expansion or Replacement from 1965-1969

Industry	*Number of Plants*	Total Capital Expenditures as Per Cent of Gross Investment
Food and Kindred Products	9	2.5
Meat slaughtering	3	3.6
Poultry dressing	–	–
Cheeses	–	–
Fluid milk	–	–
Seafoods	–	–
Canned fruits/vegetables	2	4.5
Fish	–	–
Frozen fruits/vegetables	2	1.0
Wet corn milling	2	3.8
Raw cane sugar	–	–
Cane sugar refining	–	–
Malt liquors	–	–
Distilled liquor	–	–
Textile Mill Products	4	1.1
Cotton weaving	2	1.2
Synthetics weaving	1	.2
Weaving, finishing, wool	1	4.6
Cotton finishing	–	–
Synthetic finishing	–	–
Paper and Allied Products	20	2.9
Pulp mills	5	3.6
Paper mills	6	4.1
Paperboard mills	4	1.9
Paper products	3	1.7
Building paper/board mills	2	1.1
Chemicals and Allied Products	41	.8
Alkalies/chlorine	4	.5
Coal tar products	1	6.0
Organic chemicals	10	.7
Inorganic chemicals	5	1.9
Plastics/resins	5	.4
Synthetic rubber	1	.5
Cellulosic man-made fibers	3	1.9
Organic fibers, noncellulose	4	.7
Pharmaceuticals	3	2.9
Detergents	–	–
Gum and wood chemicals	1	1.5
Fertilizers	1	2.0
Agricultural pesticides	–	–
Glue and gelatin	–	–
Explosives	1	5.5
Carbon black	2	.1
Petroleum and Coal Products	7	.6
Petroleum refining	6	.6
Lubricating oils/greases	1	.7
Rubber and Plastics Products	7	.6
Tires/tubes	2	.4
Rubber products	2	1.2
Plastics products	3	.8
Primary Metal Industries	10	1.2
Blast furnaces/steel	2	1.4
Steel pipe/tube	–	–
Gray iron foundries	–	–
Primary copper	–	–
Primary aluminum	3	.6
Copper rolling/drawing	2	8.5
Aluminum rolling/drawing	3	.9
Total	98	1.3

VII: Ratio of 5-year Capital Expenditures to Gross Investment in Plants Built Within Past 5 Years, by Industry

Industry	Number of Plants Built in Last 5 Years	Total Capital Expenditures as Per Cent of Gross Investment
Food and Kindred Products	2	3.8%
Meat slaughtering	2	3.8
Poultry dressing	–	–
Cheeses	–	–
Fluid milk	–	–
Seafoods	–	–
Canned fruits/vegetables	–	–
Fish	–	–
Frozen fruits/vegetables	–	–
Wet corn milling	–	–
Raw cane sugar	–	–
Cane sugar refining	–	–
Malt liquors	–	–
Distilled liquor	–	–
Textile Mill Products	3	.8
Cotton weaving	1	.3
Synthetics weaving	1	.2
Weaving, finishing, wool	1	4.6
Cotton finishing	–	–
Synthetic finishing	–	–
Paper and Allied Products	11	3.4
Pulp mills	5	3.6
Paper mills	2	5.2
Paperboard mills	1	2.2
Paper products	1	.9
Building paper/board mills	2	1.1
Chemicals and Allied Products	7	.9
Alkalies/chlorine	–	–
Coal tar products	1	6.0
Organic chemicals	2	.9
Inorganic chemicals	1	.9
Plastics/resins	–	–
Synthetic rubber	–	–
Cellulosic man-made fibers	–	–
Organic fibers, noncellulose	1	.7
Pharmaceuticals	1	.6
Detergents	–	–
Gum and wood chemicals	–	–
Fertilizers	–	–
Agricultural pesticides	–	–
Glue and gelatin	–	–
Explosives	1	5.5
Carbon black	–	–
Petroleum and Coal Products	–	–
Petroleum refining	–	–
Lubricating oils/greases	–	–
Rubber and Plastics Products	3	.6
Tires/tubes	2	.4
Rubber products	1	1.3
Plastics products	–	–
Primary Metal Industries	3	2.4
Blast furnaces/steel	–	–
Steel pipe/tube	–	–
Gray iron foundries	–	–
Primary copper	–	–
Primary aluminum	–	–
Copper rolling/drawing	1	.3
Aluminum rolling/drawing	2	2.9
Total	29	2.4%

VIII: Ratio of 1969 Capital Expenditures to Value Added by Manufacture, by Industry

Industry	Number	Capital Expenditures/ Value Added
Food and kindred products	27	.8%
Meat slaughtering	8	.7
Poultry dressing	1	4.3
Cheeses	2	2.8
Fluid milk	2	.1
Seafoods	–	–
Canned fruits/vegetables	4	.1
Fish	–	–
Frozen fruits/vegetables	3	.1
Wet corn milling	3	.7
Raw cane sugar	2	.1
Cane sugar refining	2	1.2
Malt liquors	–	–
Distilled liquor	–	–
Textile mill products	12	.9
Cotton weaving	4	.6
Synthetics weaving	1	1.9
Weaving, finishing, wool	1	15.4
Cotton finishing	4	.4
Synthetic finishing	2	1.7
Paper and allied products	77	3.1
Pulp mills	13	4.2
Paper mills	36	3.8
Paperboard mills	19	.8
Paper products	6	2.8
Building paper/board mills	3	8.5
Chemicals and allied products	84	.8
Alkalies/chlorine	6	1.2
Coal tar products	1	.1
Organic chemicals	13	2.0
Inorganic chemicals	12	.8
Plastics/resins	9	.5
Synthetic rubber	5	.8
Cellulosic man-made fibers	7	2.3
Organic fibers, noncellulose	1	.3
Pharmaceuticals	5	.4
Detergents	14	.5
Gum and wood chemicals	3	.3
Fertilizers	2	1.0
Agricultural pesticides	1	.8
Glue and gelatin	2	.2
Explosives	3	.2
Carbon black	–	–
Petroleum and coal products	17	1.7
Petroleum refining	16	1.7
Lubricating oils/greases	1	.2
Rubber and plastics products	12	.1
Tires/tubes	5	.1
Rubber products	3	.3
Plastics products	4	.3
Primary metal industries	38	.7
Blast furnaces/steel	9	.6
Steel pipe/tube	3	.3
Gray iron foundries	5	.9
Primary copper	3	.3
Primary aluminum	8	.3
Copper rolling/drawing	6	3.6
Aluminum rolling/drawing	4	.2
Total	267	1.2%

IX: Number Making Capital Expenditures, by Type of Abatement Facilities, by Industry, 1969

Industry	Expenditures for: Manufacturing Change — Number	Wastewater Treatment — Number	Cooling — Number	Other — Number
Food and Kindred Products	10	37	2	4
Meat slaughtering	2	11	–	–
Poultry dressing	1	3	–	–
Cheeses	–	2	–	–
Fluid milk	–	–	2	–
Seafoods	–	–	–	–
Canned fruits/vegetables	–	9	–	1
Fish	1	–	–	–
Frozen fruits/vegetables	–	7	–	–
Wet corn milling	3	2	–	–
Raw cane sugar	–	2	–	–
Cane sugar refining	2	–	–	2
Malt liquors	1	1	–	–
Distilled liquor	–	–	–	1
Textile Mill Products	4	34	1	4
Cotton weaving	1	18	1	1
Synthetics weaving	–	6	–	1
Weaving, finishing, wool	–	4	–	2
Cotton finishing	3	4	–	–
Synthetic finishing	–	2	–	–
Paper and Allied Products	51	73	4	13
Pulp mills	8	12	–	2
Paper mills	25	35	1	7
Paperboard mills	8	16	1	3
Paper products	6	7	1	1
Building paper/board mills	4	3	1	–
Chemicals and Allied Products	84	134	12	28
Alkalies/chlorine	6	8	1	2
Coal tar products	1	4	–	–
Organic chemicals	17	29	4	7
Inorganic chemicals	12	16	–	5
Plastics/resins	6	15	1	1
Synthetic rubber	5	8	–	–
Cellulosic man-made fibers	5	10	1	1
Organic fibers, noncellulose	2	6	–	1
Pharmaceuticals	4	9	1	1
Detergents	14	9	3	6
Gum and wood chemicals	–	3	–	–
Fertilizers	4	3	1	1
Agricultural pesticides	3	1	–	1
Glue and gelatin	1	3	–	1
Explosives	3	8	–	1
Carbon black	1	2	–	–
Petroleum and Coal Products	11	40	3	3
Petroleum refining	11	39	3	3
Lubricating oils/greases	–	1	–	–
Rubber and Plastics Products	4	21	3	3
Tires/tubes	1	7	–	1
Rubber products	–	8	2	1
Plastics products	3	6	1	1
Primary Metal Industries	14	39	10	12
Blast furnaces/steel	2	10	5	3
Steel pipe/tube	–	5	–	–
Gray iron foundries	1	8	1	1
Primary copper	2	1	–	–
Primary aluminum	2	6	1	4
Copper rolling/drawing	5	4	1	2
Aluminum rolling/drawing	2	5	2	2
Total	178	378	35	67

X: 5-year Capital Expenditures as a Per Cent of Gross Investment, by Size of Plant, by Industry

Industry	20-99 No.	20-99 Capital Expenditures/ Gross Investment	100-499 No.	100-499 Capital Expenditures/ Gross Investment	500-999 No.	500-999 Capital Expenditures/ Gross Investment	1000+ No.	1000+ Capital Expenditures/ Gross Investment
Food and Kindred Products	6	2.0%	13	3.0%	15	1.4%	12	.5%
Meat slaughtering	1	.9	3	1.0	4	2.7	4	.4
Poultry dressing	–	–	3	8.8	1	.1	–	–
Cheeses	2	3.6	–	–	–	–	–	–
Fluid milk	–	–	–	–	–	–	–	–
Seafoods	–	–	–	–	–	–	1	.3
Canned fruits/vegetables	2	2.5	3	5.2	2	1.0	–	–
Fish	–	–	–	–	1	1.0	–	–
Frozen fruits/vegetables	–	–	1	2.6	1	.7	5	1.7
Wet corn milling	–	–	1	4.7	2	3.1	1	.3
Raw cane sugar	–	–	1	.1	1	.1	–	–
Cane sugar refining	1	.2	–	–	2	.6	–	–
Malt liquors	–	–	–	–	1	*	1	.1
Distilled liquor	–	–	1	*	–	–	–	–
Textile Mill Products	–	–	6	1.4	15	.9	14	.7
Cotton weaving	–	–	3	.8	5	1.1	10	.7
Synthetics weaving	–	–	1	.8	2	.4	2	.5
Weaving, finishing, wool	–	–	1	4.6	2	.3	2	.7
Cotton finishing	–	–	1	*	4	.6	–	–
Synthetic finishing	–	–	–	–	2	2.5	–	–
Paper and Allied Products	2	7.5	35	3.4	27	2.2	28	1.9
Pulp mills	–	–	6	4.8	7	2.6	3	.6
Paper mills	1	3.0	13	4.0	11	3.3	19	2.1
Paperboard mills	1	8.0	9	1.0	7	1.5	4	1.0
Paper products	–	–	5	1.7	1	.2	2	1.6
Building paper/board mills	–	–	2	1.1	1	1.8	–	–
Chemicals and Allied Products	12	2.0	45	.9	40	1.1	43	.9
Alkalies/chlorine	1	.4	4	1.2	2	.7	4	.5
Coal tar products	1	6.0	–	–	–	–	1	2.3
Organic chemicals	–	–	11	.7	8	1.2	9	.7
Inorganic chemicals	3	1.8	9	.7	5	1.4	1	4.6
Plastics/resins	1	1.7	3	.5	5	.5	4	.9
Synthetic rubber	–	–	–	–	4	.5	1	.8
Cellulosic man-made fibers	1	.4	2	2.6	–	–	7	.7
Organic fibers, noncellulose	–	–	–	–	3	.7	1	.7
Pharmaceuticals	–	–	4	.9	4	2.2	2	1.0
Detergents	–	–	4	.3	8	1.4	5	1.3
Gum and wood chemicals	–	–	2	1.2	–	–	1	*
Fertilizers	1	.1	2	.7	–	–	1	2.0
Agricultural pesticides	2	3.2	–	–	1	4.7	–	–
Glue and gelatin	1	.5	1	*	–	–	2	.8
Explosives	1	5.5	1	.1	–	–	4	1.1
Carbon black	–	–	2	.1	–	–	–	–
Petroleum and Coal Products	2	.6	9	6.0	11	.9	5	.8
Petroleum refining	1	.5	8	6.2	11	.9	5	.8
Lubricating oils/grease	1	.7	1	.1	–	–	–	–
Rubber and Plastics Products	2	39.5	6	.7	4	.7	9	.1
Tires/tubes	1	41.5	–	–	1	.5	7	.1
Rubber products	1	11.1	1	.1	2	1.1	2	.4
Plastics products	–	–	5	.7	1	*	–	–
Primary Metal Industries	2	1.3	8	2.1	16	.5	32	.5
Blast furnaces/steel	–	–	1	.3	3	1.4	8	.5
Steel pipe/tube	–	–	–	–	3	.7	1	1.0
Gray iron foundries	–	–	1	1.3	2	.8	7	.9
Primary copper	–	–	–	–	2	.1	1	.2
Primary aluminum	–	–	1	2.9	3	.6	7	.1
Copper rolling/drawing	1	.5	3	1.0	1	.6	4	2.5
Aluminum rolling/drawing	1	4.7	2	2.3	1	.1	4	.2
Total	25	2.4	122	2.4	128	1.3	143	.9

* Less than .05%

XI: 5-year Capital Expenditures as a Per Cent of Book Value, by Size of Plant, by Industry

Industry	20-99 No.	20-99 Capital Expenditures/ Book Value	100-499 No.	100-499 Capital Expenditures/ Book Value	500-999 No.	500-999 Capital Expenditures/ Book Value	1000+ No.	1000+ Capital Expenditures/ Book Value
Food and Kindred Products	6	3.8%	14	4.3%	14	2.4%	13	1.1%
Meat slaughtering	1	3.2	3	1.7	4	4.5	4	1.1
Poultry dressing	–	–	3	19.9	1	.3	–	–
Cheeses	2	9.9	–	–	–	–	–	–
Fluid milk	–	–	1	.3	–	–	1	.3
Seafoods	–	–	–	–	–	–	1	.6
Canned fruits/vegetables	2	3.5	3	8.2	1	1.7	–	–
Fish	–	–	–	–	1	1.9	–	–
Frozen fruits/vegetables	–	–	1	2.7	1	2.5	5	2.8
Wet corn milling	–	–	1	7.5	2	5.3	1	.7
Raw cane sugar	–	–	1	.3	1	.2	–	–
Cane sugar refining	1	.3	–	–	2	.9	–	–
Malt liquors	–	–	–	–	1	*	1	.3
Distilled liquor	–	–	1	*	–	–	–	–
Textile Mill Products	–	–	4	1.0	13	1.3	10	1.2
Cotton weaving	–	–	3	1.1	5	2.3	9	1.3
Synthetics weaving	–	–	–	–	2	.5	1	.4
Weaving, finishing, wool	–	–	–	–	1	1.9	–	–
Cotton finishing	–	–	1	.1	4	1.7	–	–
Synthetic finishing	–	–	–	–	1	.4	–	–
Paper and Allied Products	2	25.1	35	4.5	27	3.5	30	3.7
Pulp mills	–	–	5	6.1	7	3.7	3	1.2
Paper mills	1	24.4	14	5.1	11	6.7	21	4.0
Paperboard mills	1	25.2	9	2.4	7	2.0	4	2.6
Paper products	–	–	5	2.6	1	.7	2	3.4
Building paper/board mills	–	–	2	1.3	1	5.0	–	–
Chemicals and Allied Products	12	3.3	43	1.7	38	2.3	42	2.1
Alkalies/chlorine	1	2.0	4	2.3	2	2.0	4	1.8
Coal tar products	1	9.0	–	–	–	–	1	5.0
Organic chemicals	–	–	11	1.2	8	2.4	9	1.6
Inorganic chemicals	3	2.9	8	1.8	3	4.2	1	8.2
Plastics/resins	1	2.6	2	3.6	4	1.2	4	1.7
Synthetic rubber	–	–	–	–	4	1.0	1	3.3
Cellulosic man-made fibers	1	.5	2	4.2	–	–	6	1.2
Organic fibers, noncellulose	–	–	–	–	3	1.3	1	.8
Pharmaceuticals	–	–	4	1.5	4	3.6	2	1.6
Detergents	–	–	4	.6	8	2.9	5	2.8
Gum and wood chemicals	–	–	2	3.4	–	–	1	.1
Fertilizers	1	.2	2	1.6	1	1.4	1	3.1
Agricultural pesticides	2	9.5	1	3.1	1	8.1		–
Glue and gelatin	1	.6	1	.1	–	–	2	2.4
Explosives	1	11.1	1	.3	–	–	4	1.3
Carbon black	–	–	1	.3	–	–	–	–
Petroleum and Coal Products	2	1.3	9	18.9	11	1.9	5	1.9
Petroleum refining	1	1.6	8	19.2	11	1.9	5	1.9
Lubricating oils/greases	1	.9	1	.6	–	–	–	–
Rubber and Plastics Products	2	21.5	6	1.1	4	1.2	9	.3
Tires/tubes	1	46.3	–	–	1	1.3	7	.2
Rubber products	1	.7	1	.2	2	1.7	2	.8
Plastics products	–	–	5	1.2	1	.1	–	–
Primary Metal Industries	2	3.4	8	3.1	16	.9	32	1.2
Blast furnaces/steel	–	–	1	.8	3	2.1	8	1.1
Steel pipe/tube	–	–	–	–	4	1.4	1	2.2
Gray iron foundries	–	–	1	4.1	2	1.7	7	2.0
Primary copper	–	–	–	–	2	.2	1	.4
Primary aluminum	–	–	1	3.8	3	1.1	7	.3
Copper rolling/drawing	1	1.9	3	1.8	1	.6	4	4.8
Aluminum rolling/drawing	1	5.2	2	3.2	1	.1	4	.5
Total	26	4.4	119	4.3	123	2.4	141	2.0

* Less than .05%

APPENDIX C
Data on Annual Expenditures for Operation and Maintenance

XII. Total Annual Operating Expenditures, by Size of Plant, by Industry, 1969

XIII. Ratio of Annual Operating Expenditures to Gross Investment, by Size of Plant, by Industry, 1969

XIV. Ratio of Annual Operating Expenditures to Book Value, by Size of Plant, by Industry, 1969

XV. Ratio of Annual Operating Expenditures to Total Payroll, by Size of Plant, by Industry, 1969

XVI. Annual Operating Expenditures per Production Employee, by Size of Plant, by Industry, 1969

XVII. Ratio of Annual Operating Expenditures to Value of Shipments, by Size of Plant, by Industry, 1969

XVIII. Ratio of Annual Operating Expenditures to Cost of Materials, by Size of Plant, by Industry, 1969

XIX. Ratio of Annual Operating Expenditures to Value Added by Manufacture and by Gross Operating Margin, by Size of Plant, by Industry, 1969

XX. Annual Operating Expenditures, by Number of Employees Engaged in Abatement Activities, by Industry, 1969

XXI. Annual Operating Expenditures per Volume of Wastewater Discharged Annually, by Size of Plant, by Industry, 1969

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XII: Total Annual Operating Expenditures, by Size of Plant, by Industry, 1969

Industry	20-99		100-499		500-999		1000+	
	Number of Plants	Operating Expenditures ($000)	Number of Plants	Operating Expenditures ($000)	Number of Plants	Operating Expenditures ($000)	Number of Plants	Operating Expenditures ($000)
Food and Kindred Products	6	$ 30	18	$292	15	$ 655	14	$459
Meat slaughtering	1	1	3	71	5	60	7	212
Poultry dressing	–	–	2	19	1	42	–	–
Cheeses	1	10	–	–	–	–	–	–
Fluid milk	1	5	3	10	–	–	1	6
Seafoods	–	–	–	–	–	–	–	–
Canned fruits/vegetables	2	7	5	67	4	113	–	–
Fish	–	–	–	–	1	7	–	–
Frozen fruits/vegetables	1	7	1	50	1	153	5	216
Wet corn milling	–	–	1	70	2	260	1	25
Raw cane sugar	–	–	1	1	1	20	–	–
Cane sugar refining	–	–	–	–	–	–	–	–
Malt liquors	–	–	–	–	–	–	–	–
Distilled liquor	–	–	2	4	–	–	–	–
Textile Mill Products	–	–	6	37	14	183	11	1,134
Cotton weaving	–	–	3	5	6	81	7	1,016
Synthetics weaving	–	–	1	7	2	5	3	113
Weaving, finishing, wool	–	–	1	10	1	3	1	5
Cotton finishing	–	–	1	15	4	34	–	–
Synthetic finishing	–	–	–	–	1	60	–	–
Paper and Allied Products	2	20	29	2,724	21	2,614	27	4,973
Pulp mills	–	–	6	590	5	789	3	100
Paper mills	1	1	9	1,130	8	1,305	18	3,250
Paperboard mills	1	19	7	337	7	519	4	1,206
Paper products	–	–	5	619	1	1	2	417
Building paper/board mills	–	–	2	48	–	–	–	–
Chemicals and Allied Products	13	410	62	4,435	45	8,640	65	25,415
Alkalies/chlorine	3	53	4	105	2	148	4	770
Coal tar products	1	90	3	173	–	–	2	3,784
Organic chemicals	–	–	15	1,913	9	2,378	11	6,124
Inorganic chemicals	3	230	11	1,421	5	2,455	3	3,925
Plastics/resins	1	10	3	52	7	1,628	12	2,863
Synthetic rubber	–	–	–	–	4	874	2	1,682
Cellulosic man-made fibers	1	14	3	175	–	–	10	1,301
Organic fibers, noncellulose	–	–	1	18	2	294	4	544
Pharmaceuticals	–	–	5	77	6	160	3	779
Detergents	–	–	3	51	7	302	5	552
Gum and wood chemicals	1	3	1	37	–	–	–	–
Fertilizers	1	5	5	299	1	200	2	2,181
Agricultural pesticides	–	–	1	15	1	150	–	–
Glue and gelatin	–	–	1	25	–	–	2	252
Explosives	1	3	2	32	1	51	5	658
Carbon black	1	2	4	42	–	–	–	–
Petroleum and Coal Products	4	52	10	809	13	2,772	9	4,241
Petroleum refining	3	50	9	799	13	2,772	9	4,241
Lubricating oils/greases	1	2	1	10	–	–	–	–
Rubber and Plastics Products	1	1	5	9	4	44	12	152
Tires/tubes	–	–	1	1	–	–	7	45
Rubber products	1	1	1	2	2	9	3	69
Plastics products	–	–	3	6	2	35	2	38
Primary Metal Industries	–	–	6	171	19	678	32	4,455
Blast furnaces/steel	–	–	–	–	3	158	9	3,096
Steel pipe/tube	–	–	–	–	4	182	1	50
Gray iron foundries	–	–	1	26	2	14	6	268
Primary copper	–	–	–	–	2	53	1	109
Primary aluminum	–	–	2	89	2	149	10	674
Copper rolling/drawing	–	–	2	18	3	35	2	90
Aluminum rolling/drawing	–	–	1	38	3	87	3	168
Total	26	$513	136	$8,477	131	$15,586	170	$40,829

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XIII: Ratio of Annual Operating Expenditures to Gross Investment, by Size of Plant, by Industry, 1969

Industry	20-99		100-499		500-999		1000+	
	No.	A.O.E./ Gross Investment	No.	A.O.E./ Gross Investment	No.	A.O.E./ Gross Investment	No.	A.O.E./ Gross Investment
Food and kindred products	6	.6%	15	.4%	13	.2%	13	.1%
Meat slaughtering	1	.1	3	.6	5	.1	7	.2
Poultry dressing	–	–	2	.8	1	.6	–	–
Cheeses	1	.9	–	–	1	*	–	–
Fluid milk	1	.6	1	.2	–	–	–	–
Seafoods	–	–	–	–	–	–	–	–
Canned fruits/vegetables	2	.6	4	.4	2	.1	–	–
Fish	–	–	–	–	1	.2	–	–
Frozen fruits/vegetables	1	.5	1	4.3	1	1.2	5	.3
Wet corn milling	–	–	1	.8	1	.2	1	*
Raw cane sugar	–	–	1	*	1	.2	–	–
Cane sugar refining	–	–	–	–	–	–	–	–
Malt liquors	–	–	–	–	–	–	–	–
Distilled liquor	–	–	2	*	–	–	–	–
Textile mill products	–	–	6	.1	13	.1	10	.3
Cotton weaving	–	–	3	*	5	.1	7	.4
Synthetics weaving	–	–	1	.1	2	*	2	.2
Weaving, finishing, wool	–	–	1	.1	1	*	1	.1
Cotton finishing	–	–	1	.2	4	.1	–	–
Synthetic finishing	–	–	–	–	1	.6	–	–
Paper and allied products	2	.5	27	.4	21	.3	27	.3
Pulp mills	–	–	6	.3	5	.3	3	.1
Paper mills	1	.3	8	.6	8	.7	18	.2
Paperboard mills	1	.5	7	.4	7	.1	4	.6
Paper products	–	–	5	.5	1	*	2	.4
Building paper/board mills	–	–	1	.2	–	–	–	–
Chemicals and allied products	13	.9	50	.3	30	.4	45	.3
Alkalies/chlorine	3	.5	4	.1	2	.1	4	.1
Coal tar products	1	2.8	2	1.3	–	–	2	1.1
Organic chemicals	–	–	13	.4	8	.3	9	.2
Inorganic chemicals	3	1.3	8	.7	5	.8	1	.7
Plastics/resins	1	.3	3	.1	5	.6	5	.3
Synthetic rubber	–	–	–	–	3	.3	1	.3
Cellulosic man-made fibers	1	.7	2	.2	–	–	7	.4
Organic fibers, noncellulose	–	–	–	–	2	.3	1	.2
Pharmaceuticals	–	–	5	.3	6	.2	3	.3
Detergents	–	–	3	.1	7	.2	5	.2
Gum and wood chemicals	1	.1	1	.4	–	–	–	–
Fertilizers	1	.1	3	.3	–	–	1	1.9
Agricultural pesticides	–	–	–	–	1	.9	–	–
Glue and gelatin	–	–	1	.2	–	–	2	.2
Explosives	1	.2	1	.1	–	–	4	.1
Carbon black	1	.1	4	.1	–	–	–	–
Petroleum and coal products	3	.5	6	.4	10	.2	4	.2
Petroleum refining	2	.6	5	.4	10	.2	4	.3
Lubricating oils/greases	1	.1	1	.2	–	–	–	–
Rubber and plastics products	–	–	5	*	3	.1	11	*
Tires/tubes	–	–	1	*	–	–	7	*
Rubber products	–	–	1	*	2	*	3	.1
Plastics products	–	–	3	*	1	.3	1	*
Primary metal industries	–	–	6	.1	18	.1	31	.1
Blast furnaces/steel	–	–	–	–	3	.3	8	.2
Steel pipe/tube	–	–	–	–	4	.3	1	*
Gray iron foundries	–	–	1	.5	2	.1	6	.1
Primary copper	–	–	–	–	2	.1	1	.2
Primary aluminum	–	–	2	.1	2	.1	10	*
Copper rolling/drawing	–	–	2	.1	3	.1	2	.1
Aluminum rolling/drawing	–	–	1	.1	2	.1	3	.1
Total	24	.8%	116	.3%	117	.3%	141	.2%

*Less than .05%

XIV: Ratio of Annual Operating Expenditures to Book Value, by Size of Plant, by Industry, 1988

Industry	[illegible]		[illegible]		[illegible]		[illegible]	
	No.	A.O.E./ Book Value	No.	A.O.E./ Book Value	No.	A.O.E./ Book Value	No.	A.O.E./ Book Value
Food and kindred products	6	1.0%	17	.5%	13	5%	10	.3%
Meat slaughtering	1	.4	2	1.0	0	.2	1	.0
Poultry dressing	–	–	2	1.7	1	1.0	–	–
Cheese	1	2.7	–	–	1	*	–	–
Fluid milk	1	1.1	3	.1	–	–	1	*
Seafoods	–	–	–	–	–	–	–	–
Canned fruits/vegetables	2	.0	4	.7	2	.2	–	–
Fish	–	–	–	–	1	.0	–	–
Frozen fruits/vegetables	1	.0	1	6.6	1	4.2	0	.0
Wet corn milling	–	–	1	1.2	1	.2	1	*
Raw cane sugar	–	–	1	.1	1	.0	–	–
Cane sugar refining	–	–	–	–	–	–	–	–
Malt liquors	–	–	–	–	–	–	–	–
Distilled liquor	–	–	2	*	–	–	–	–
Textile mill products	–	–	4	.1	11	.1	0	.0
Cotton weaving	–	–	3	*	5	.2	1	.0
Synthetics weaving	–	–	–	–	2	*	1	.1
Weaving, finishing, wool	–	–	–	–	–	–	–	–
Cotton finishing	–	–	1	.0	.0	.2	–	–
Synthetic finishing	–	–	–	–	–	–	–	–
Paper and allied products	2	1.7	28	.0	21	.0	27	.0
Pulp mills	–	–	5	.0	0	.0	1	*
Paper mills	1	2.6	6	.0	0	1.3	18	.0
Paperboard mills	1	1.7	7	.0	7	.2	6	1.0
Paper products	–	–	5	.0	1	*	2	.0
Building paper/board mills	–	–	1	.2	–	–	–	–
Chemicals and allied products	12	1.0	47	.0	31	.1	60	.1
Alkalies/chlorine	3	1.1	4	.2	2	.2	0	.0
Coal tar products	1	4.1	2	3.4	–	–	2	3.0
Organic chemicals	–	–	13	.1	8	.0	0	.0
Inorganic chemicals	3	2.1	7	1.0	2	3.0	1	1.1
Plastics/resins	1	.8	2	1.1	6	1.1	0	.0
Synthetic rubber	–	–	–	–	2	.1	1	1.0
Cellulosic man-made fibers	1	.0	2	.0	–	–	0	.0
Organic fibers, noncellulosic	–	–	–	–	2	.0	1	.1
Pharmaceuticals	–	–	5	.0	0	.0	1	.0
Detergents	–	–	3	.2	1	.2	0	.0
Gum and wood chemicals	1	.1	1	1.2	–	–	–	–
Fertilizers	1	.2	3	.0	1	.0	1	1.0
Agricultural pesticides	–	–	1	.2	1	1.0	–	–
Glue and gelatin	–	–	1	.0	–	–	1	.0
Explosives	1	.0	1	.1	–	–	0	.1
Carbon black	–	–	2	.1	–	–	–	–
Petroleum and coal products	2	1.2	6	1.0	10	.0	0	.0
Petroleum refining	2	1.0	5	1.0	10	.0	0	.0
Lubricating oils/greases	1	.1	1	.0	–	–	–	–
Rubber and plastics products	1	.2	5	.1	5	.2	10	.1
Tires/tubes	–	–	1	.1	–	–	1	.1
Rubber products	1	.2	1	.1	2	.1	1	.0
Plastics products	–	–	3	.1	3	.0	7	.1
Primary metal industries	–	–	6	.1	11	.1	11	.1
Blast furnaces/steel	–	–	–	–	3	.0	0	.0
Steel pipe/tube	–	–	–	–	0	.0	1	.1
Gray iron foundries	–	–	1	1.7	1	.1	0	.0
Primary copper	–	–	–	–	1	.1	1	.0
Primary aluminum	–	–	1	.0	1	.0	0	.1
Copper rolling/drawing	–	–	2	.1	3	.1	1	.1
Aluminum rolling/drawing	–	–	1	.1	1	.1	1	.1
Total	28	1.4%	111	.6%	112	.4%	138	.2%

*Less than .05%

XV: Ratio of Annual Operating Expenditures to Total Payroll, by Size of Plant, by Industry, 1969

Industry	20-99		100-499		500-999		1000+	
	No.	A.O.E./ Payroll	No.	A.O.E./ Payroll	No.	A.O.E./ Payroll	No.	A.O.E./ Payroll
Food and Kindred Products	6	1.7%	17	.8%	12	.7%	14	.2%
Meat slaughtering	1	.2	3	1.1	5	.3	7	.2
Poultry dressing	–	–	2	.6	1	7.3	–	–
Cheeses	1	4.4	–	–	–	–	–	–
Fluid milk	1	2.0	3	.1	–	–	1	*
Seafoods	–	–	–	–	–	–	–	–
Canned fruits/vegetables	2	1.7	4	.7	2	.2	–	–
Fish		–	–	–	1	.2	–	–
Frozen fruits/vegetables	1	1.9	1	2.3	1	2.8	5	.7
Wet corn milling	–	–	1	3.1	1	1.0	1	.1
Raw cane sugar	–	–	1	.3	1	.5	–	–
Cane sugar refining	–	–	–	–	–	–	–	–
Malt liquors	–	–	–	–	–	–	–	–
Distilled liquor	–	–	2	.1	–	–	–	–
Textile Mill Products	–	–	6	.4	13	.3	10	.8
Cotton weaving	–	–	3	.1	5	.3	7	1.0
Synthetics weaving	–	–	1	.3	2	.1	2	.4
Weaving, finishing, wool	–	–	1	1.0	1	.1	1	.1
Cotton finishing	–	–	1	1.1	4	.2	–	–
Synthetic finishing	–	–	–	–	1	1.8	–	–
Paper and Allied Products	2	2.1	29	3.1	21	2.1	27	1.2
Pulp mills	–	–	6	3.6	5	2.7	3	.3
Paper mills	1	.5	9	3.5	8	2.7	18	1.2
Paperboard mills	1	2.5	7	1.9	7	1.2	4	1.8
Paper products	–	–	5	3.7	1	*	2	1.4
Building paper/board mills	–	–	2	1.7	–	–	–	–
Chemicals and Allied Products	12	7.4	53	2.8	42	2.8	80	1.4
Alkalies/chlorine	3	6.7	4	1.1	2	1.3	4	1.6
Coal tar products	1	37.0	2	2.8	–	–	2	3.8
Organic chemicals	–	–	14	4.3	8	3.7	10	1.4
Inorganic chemicals	3	20.1	8	5.9	5	7.1	2	2.3
Plastics/resins	–	–	3	.6	6	3.9	11	1.2
Synthetic rubber	–	–	–	–	3	2.1	2	1.8
Cellulosic man-made fibers	1	6.0	2	2.1	–	–	8	1.0
Organic fibers, noncellulose	–	–	–	–	2	1.8	4	.5
Pharmaceuticals	–	–	5	.6	6	.5	3	.8
Detergents	–	–	3	.4	7	.6	5	.5
Gum and wood chemicals	1	.5	1	.9	–	–	–	–
Fertilizers	1	.6	3	3.4	1	4.0	2	12.8
Agricultural pesticides	–	–	1	1.2	1	2.0	–	–
Glue and gelatin	–	–	1	1.4	–	–	2	.4
Explosives	1	.4	2	.5	1	.6	5	.5
Carbon black	1	.2	4	.5	–	–	–	–
Petroleum and Coal Products	3	4.0	5	3.3	10	2.6	4	2.1
Petroleum refining	2	5.3	4	3.5	10	2.6	4	2.1
Lubricating oils/greases	1	.6	1	.7	–	–	–	–
Rubber and Plastics Products	1	.3	5	.1	3	.2	12	.1
Tires/tubes	–	–	1	*	–	–	7	*
Rubber products	1	.3	1	.1	2	.1	3	.1
Plastics products	–	–	3	.1	1	.4	2	.1
Primary Metal Industries	–	–	6	.8	17	.8	30	.5
Blast furnaces/steel	–	–	–	–	3	1.3	8	.9
Steel pipe/tube	–	–	–	–	2	.5	–	–
Gray iron foundries	–	–	1	1.0	2	.1	6	.1
Primary copper	–	–	–	–	2	.6	1	.9
Primary aluminum	–	–	2	1.0	2	1.2	10	.3
Copper rolling/drawing	–	–	2	.4	3	.2	2	.3
Aluminum rolling/drawing	–	–	1	1.2	2	.4	3	.2
Total	24	5.2	131	2.4	118	1.9	187	1.0

*Less than .05%

XVI: Annual Operating Expenditure per Production Employee, by Size of Plant, by Industry, 1969

Industry	20-99 No.	20-99 A.O.E. per Production Employee	100-499 No.	100-499 A.O.E. per Production Employee	500-999 No.	500-999 A. O.E. per Production Employee	1000+ No.	1000+ A. O. E. per Production Employee
Food and Kindred Products	6	$111	18	$73	16	$69	14	$23
Meat slaughtering	1	33	3	83	5	22	7	21
Poultry dressing	–	–	2	36	1	73	–	–
Cheeses	1	238	–	–	1	1	–	–
Fluid milk	1	200	3	38	–	–	1	20
Seafoods	–	–	–	–	–	–	–	–
Canned fruits/vegetables	2	80	5	65	4	45	–	–
Fish	–	–	–	–	1	8	–	–
Frozan fruits/vegetables	1	80	1	146	1	229	5	36
Wet corn milling	–	–	1	203	2	233	1	7
Raw cane sugar	–	–	1	12	1	42	–	–
Cane sugar refining	–	–	–	–	–	–	–	–
Malt liquors	–	–	–	–	–	–	–	–
Distilled liquor	–	–	2	7	–	–	–	–
Textile Mill Products	–	–	6	26	14	21	11	49
Cotton weaving	–	–	3	6	6	19	7	56
Synthetics weaving	–	–	1	19	2	4	3	27
Weaving, finishing, wool	–	–	1	100	1	5	1	6
Cotton finishing	–	–	1	97	4	16	–	–
Synthetic finishing	–	–	–	–	1	126	–	–
Paper and Allied Products	2	182	29	359	21	233	27	135
Pulp mills	–	–	6	423	5	282	3	31
Paper mills	1	33	9	401	8	291	18	129
Paperboard mills	1	237	7	210	7	152	4	219
Paper products	·	·	5	418	1	2	2	137
Building paper/board mills	–	–	2	159	–	–	–	–
Chemicals and Allied Products	13	806	56	363	43	399	62	211
Alkalies/chlorine	3	541	4	166	2	158	4	237
Coal tar products	1	3,214	2	345	–	–	2	572
Organic chemicals	–	–	15	633	9	526	10	215
Inorganic chemicals	3	2,347	9	675	5	1,028	3	1,066
Plastics/resins	1	167	3	108	6	578	11	143
Synthetic rubber	–	–	–	–	3	322	2	313
Cellulosic man-made fibers	1	1,077	2	339	–	–	9	85
Organic fibers, noncellulose	–	–	1	105	2	369	4	69
Pharmaceuticals	–	–	5	70	6	50	3	143
Detergents	–	–	3	54	7	88	5	89
Gum and wood chemicals	1	94	1	134	–	–	–	–
Fertilizers	1	68	3	356	1	566	2	1,157
Agricultural pesticides	–	–	1	100	1	894	–	–
Glue and gelatin	–	–	1	118	–	–	2	49
Explosives	1	143	2	56	1	95	5	59
Carbon black	1	23	4	66	–	–	–	–
Petroleum and Coal Products	3	410	8	385	12	369	6	296
Petroleum refining	2	517	7	416	12	369	6	296
Lubricating oils/greases	1	71	1	61	–	–	–	–
Rubber and Plastics Products	1	25	5	5	3	23	12	7
Tires/tubes	–	–	1	2	–	–	7	3
Rubber products	1	25	1	5	2	9	3	17
Plastics products	–	–	3	7	1	99	2	12
Primary Metal Industries	–	–	6	114	19	64	31	58
Blast furnaces/steel	–	–	–	–	3	97	8	131
Steel pipe/tube	–	–	–	–	4	70	1	11
Gray iron foundries	–	–	1	87	2	11	6	15
Primary copper	–	–	–	–	2	60	1	103
Primary aluminum	–	–	2	146	2	130	10	31
Copper rolling/drawing	–	–	2	46	3	23	2	39
Aluminum rolling/drawing	–	–	1	182	3	56	3	32
Total	29	$486	120	$279	126	$214	163	$126

XVII: Ratio of Annual Operating Expenditures to Value of Shipments, by Size of Plant, by Industry, 1969

Industry	20-99		100-499		500-999		1000+	
	No.	A.O.E./ V. of S.	No.	A.O.E./ V. of S.	No.	A.O.E./ V. of S.	No.	A.O.E./ V. of S.
Food and Kindred Products	5	.1%	17	.1%	13	.1%	14	*
Meat slaughtering	1	*	3	.1	5	*	7	*
Poultry dressing	–	–	2	.1	1	.1	–	–
Cheeses	1	.3	–	–	1	*	–	–
Fluid milk	–	–	3	*	–	–	1	*
Seafoods	–	–	–	–	–	–	–	–
Canned fruits/vegetables	2	.3	4	.1	2	*	–	–
Fish	–	–	–	–	1	*	–	–
Frozen fruits/vegetables	1	.3	1	1.5	1	.7	5	.1
Wet corn milling	–	–	1	.6	1	.1	1	*
Raw cane sugar	–	–	1	*	1	.3	–	–
Cane sugar refining	–	–	–	–	–	–	–	–
Malt liquors	–	–	–	–	–	–	–	–
Distilled liquor	–	–	2	*	–	–	–	–
Textile Mill Products	–	–	4	.1	13	.1	10	.2
Cotton weaving	–	–	1	*	5	.1	7	.2
Synthetics weaving	–	–	1	*	2	*	2	.1
Weaving, finishing, wool	–	–	1	.3	1	*	1	*
Cotton finishing	–	–	1	.4	4	.1	–	–
Synthetic finishing	–	–	–	–	1	.6	–	–
Paper and Allied Products	2	.5	27	.6	20	.4	25	.3
Pulp mills	–	–	5	.5	4	.6	3	.1
Paper mills	1	.2	8	.7	8	.7	16	.3
Paperboard mills	1	.6	7	.4	7	.2	4	.5
Paper products	–	–	5	.7	1	*	2	.4
Building paper/board mills	–	–	2	.3	–	–	–	–
Chemicals and Allied Products	12	.6	44	.3	34	.4	38	.2
Alkalies/chlorine	3	.3	4	.1	2	.1	3	.4
Coal tar products	1	1.6	2	.5	–	–	1	.2
Organic chemicals	–	–	10	.5	6	.8	5	.1
Inorganic chemicals	3	1.4	6	.6	6	.9	1	1.2
Plastics/resins	1	.2	3	.1	6	.7	5	.3
Synthetic rubber	–	–	–	–	3	.3	2	.4
Cellulosic man-made fibers	1	.5	2	.4	–	–	6	.3
Organic fibers, noncellulose	–	–	–	–	–	–	1	.3
Pharmaceuticals	–	–	4	.1	5	.1	3	.2
Detergents	–	–	3	*	7	*	5	.1
Gum and wood chemicals	1	.1	1	.3	–	–	–	–
Fertilizers	1	.1	3	.6	1	1.5	1	*
Agricultural pesticides	–	–	–	–	1	.7	–	–
Glue and gelatin	–	–	1	.3	–	–	1	*
Explosives	–	–	1	.1	–	–	4	.1
Carbon black	1	*	4	.1	–	–	–	–
Petroleum and Coal Products	3	.2	4	.2	10	.1	2	.2
Petroleum refining	2	.3	3	.2	10	.1	2	.2
Lubricating oils/greases	1	*	1	.1	–	–	–	–
Rubber and Plastics Products	1	.1	5	*	3	.1	11	*
Tires/tubes	–	–	1	*	–	–	7	*
Rubber products	1	.1	1	*	2	*	3	*
Plastics products	–	–	3	*	1	.2	1	*
Primary Metal Industries	–	–	6	.1	16	.1	30	.1
Blast furnaces/steel	–	–	–	–	3	.3	8	.3
Steel pipe/tube	–	–	–	–	2	.1	–	–
Grey iron foundries	–	–	1	.4	2	*	6	*
Primary copper	–	–	–	–	2	.1	1	.3
Primary Aluminum	–	–	2	.1	2	.1	10	*
Copper rolling/drawing	–	–	2	*	3	*	2	*
Aluminum rolling/drawing	–	–	1	.2	2	*	3	*
Total	23	.4	107	.3	109	.3	130	.2

*Less than .05%

XVIII: Ratio of Annual Operating Expenditures to Cost of Materials, by Size of Plant, by Industry, 1969

Industry	20-99		100-499		500-999		1000+	
	No.	A.O.E./ Cost of Materials	No.	A.O.E./ Cost of Materials	No.	A.O.E./ Cost of Materials	No.	A.O.E./ Cost of Materials
Food and Kindred Products	5	.1%	17	.1%	13	.1%	14	*%
Meat slaughtering	1	*	3	.1	5	*	7	*
Poultry dressing	–	–	2	.1	1	.1	–	–
Cheeses	1	.3	–	–	1	*	–	–
Fluid milk	1	.1	3	*	–	–	1	*
Seafoods	–	–	–	–	–	–	–	–
Canned fruits/vegetables	1	.9	4	.3	2	*	–	–
Fish	–	–	–	–	1	.1	–	–
Frozen fruits/vegetables	1	.4	1	2.9	1	1.6	5	.2
Wet corn milling	–	–	1	.5	1	.2	1	*
Raw cane sugar	–	–	1	.1	1	1.1	–	–
Cane sugar refining	–	–	–	–	–	–	–	–
Malt liquors	–	–	–	–	–	–	–	–
Distilled liquor	–	–	2	*	–	–	–	–
Textile Mill Products	–	–	4	.2	13	.1	11	.2
Cotton weaving	–	–	1	.1	5	.1	7	.3
Synthetics weaving	–	–	1	.1	2	*	3	.2
Weaving, finishing, wool	–	–	1	1.0	1	*	1	*
Cotton finishing	–	–	1	.7	4	.2	–	–
Synthetic finishing	–	–	–	–	1	1.1	–	–
Paper and Allied Products	2	.7	28	1.1	21	.7	27	.6
Pulp mills	–	–	6	.8	5	.9	3	.1
Paper mills	1	.4	8	1.3	8	1.3	16	.5
Paperboard mils	1	.8	7	1.0	7	.3	4	1.2
Paper products	–	–	5	1.5	1	*	2	.7
Building paper/board mills	–	–	2	.6	–	–	–	–
Chemicals and AlliedProducts	12	1.2	45	.6	37	.7	40	.5
Alkalies/chlorine	3	.6	4	.3	2	.2	3	.8
Coal tar products	1	3.6	2	1.0	–	–	1	.4
Organic chemicals	–	–	10	1.0	5	1.0	5	.2
Inorganic chenicals	3	2.4	6	1.1	5	1.7	1	2.1
Plastics/resins	1	.3	3	.2	6	1.1	5	.7
Synthetic rubber	–	–	–	–	3	.5	2	.7
Cellulosic manmade fibers	1	1.4	2	.6	–	–	6	.5
Organic fibers,noncellulose	–	–	–	–	–	–	1	1.0
Pharmaceuticals	–	–	4	.3	6	.3	3	.8
Detergents	–	–	3	.1	7	.1	5	.2
Gum and wood chemicals	1	.9	1	.6	–	–	–	–
Fertilizers	1	.2	3	1.0	1	4.2	2	4.3
Agricultural peticides	–	–	–	–	1	.7	–	–
Glue and gelatin	–	–	1	.6	–	–	1	.1
Explosives	–	–	2	.3	1	.4	5	.3
Carbon black	1	*	4	.3	–	–	–	–
Petroleum and Coal Poducts	3	.4	4	.2	10	.2	2	.3
Petroleum refining	2	.5	3	.2	10	.2	2	.3
Lubricating oil/greases	1	.1	1	.1	–	–	–	–
Rubber and Plastics Poducts	1	.1	5	*	3	.1	11	*
Tires/tubes	–	–	1	*	–	–	7	*
Rubber products	1	.1	1	*	2	.1	3	.1
Plastics products	–	–	3	.1	1	.2	1	*
Primary Metal Industries	–	–	6	.2	16	.2	30	.2
Blast furnaces/steel	–	–	–	–	3	.4	8	.7
Steel pipe/tube	–	–	–	–	2	.2	–	–
Gray iron foundries	–	–	1	1.0	2	.1	6	.1
Primary copper	–	–	–	–	2	.3	1	1.0
Primary aluminum	–	–	2	.3	2	.2	10	.1
Copper rolling/drawing	–	–	2	*	3	.1	2	.1
Aluminum rolling/drawing	–	–	1	.2	2	.1	3	.1
Total	23	.7	109	.5	113	.4	135	.3

*Less than .05%

XIX: Ratio of Annual Operating Expenditures to Value Added by Manufacture and by Gross Operating Margin, by Size of Plant, by Industry, 1969

Industry	20-99			100-499			500-999			1000+		
	No.	A.O.E./ Value Added	A.O.E./ G.O.M.	No.	A.O.E./ Value Added	A.O.E./ G.O.M.	No.	A.O.E./ Value Added	A.O.E./ G.O.M.	No.	A.O.E./ Value Added	A.O.E./ G.O.M.
Food and kindred products	2	1.7%	3.7%	15	.1%	.2%	12	.3%	.5%	14	.1%	.3%
Meat slaughtering	–	–	–	3	.5	.8	5	.1	.2	7	.1	.4
Poultry dressing	–	–	–	2	.2	.3	1	.5	.6	–	–	–
Cheeses	–	–	–	–	–	–	–	–	–	–	–	–
Fluid milk	–	–	–	3	.1	.3	–	–	–	1	*	.2
Seafoods	–	–	–	–	–	–	–	–	–	–	–	–
Canned fruits/vegetables	1	1.1	1.6	4	.3	.6	2	.2	4.2	–	–	–
Fish	–	–	–	–	–	–	1	.1	.2	–	–	–
Frozen fruits/vegetables	1	1.1	2.5	–	–	–	1	1.4	2.9	5	.2	.3
Wet corn milling	–	–	–	–	–	–	1	.2	.2	1	*	*
Raw cane sugar	–	–	–	1	.1	.2	1	.4	1.5	–	–	–
Cane sugar refining	–	–	–	–	–	–	–	–	–	–	–	–
Malt liquors	–	–	–	–	–	–	–	–	–	–	–	–
Distilled liquor	–	–	–	2	*	*	–	–	–	–	–	–
Textile mill products	–	–	–	4	.4	1.1	13	.2	.5	10	.6	1.7
Cotton weaving	–	–	–	1	.1	.3	5	.2	.3	7	.7	2.4
Synthetics weaving	–	–	–	1	.2	.5	2	*	.2	2	.2	.4
Weaving, finishing, wool	–	–	–	1	.5	.9	1	*	.1	1	*	.1
Cotton finishing	–	–	–	1	.9	7.2	4	.2	.6	–	–	–
Synthetic finishing	–	–	–	–	–	–	1	1.3	5.7	–	–	–
Paper and allied products	–	–	–	27	1.5	2.7	20	1.0	1.9	25	.7	1.9
Pulp mills	–	–	–	5	1.5	2.6	4	1.6	3.6	3	.2	.6
Paper mills	–	–	–	8	2.0	4.0	8	1.6	3.8	16	.7	1.8
Paperboard mills	–	–	–	7	.9	1.6	7	.5	.7	4	1.1	2.5
Paper products	–	–	–	5	1.5	2.5	1	*	*	2	.8	2.0
Building paper/board mills	–	–	–	2	.6	1.0	–	–	–	–	–	–
Chemicals and allied products	10	1.4	1.6	41	.6	.9	33	.8	1.2	36	.4	.8
Alkalies/chlorine	3	.6	.7	4	.4	.6	2	.4	.6	3	.9	2.3
Coal tar products	1	3.1	3.4	2	1.3	2.3	–	–	–	1	.5	1.2
Organic chemicals	–	–	–	10	1.5	2.4	5	3.6	51.4	5	.4	.9
Inorganic chemicals	3	4.0	5.0	5	1.8	3.5	5	2.3	3.5	1	3.4	10.2
Plastics/resins	–	–	–	3	.2	.4	5	1.6	2.3	5	.6	1.2
Synthetic rubber	–	–	–	–	–	–	3	.7	1.0	2	.9	1.7
Cellulosic man-made fibers	1	1.0	1.2	2	1.2	3.2	–	–	–	6	.9	3.0
Organic fibers, noncellulose	–	–	–	–	–	–	–	–	–	1	.5	.7
Pharmaceuticals	–	–	–	4	.1	.2	5	.1	.2	3	.2	.3
Detergents	–	–	–	3	*	*	7	.1	.1	5	.1	.2
Gum and wood chemicals	1	.1	.1	1	.6	1.4	–	–	–	–	–	–
Fertilizers	1	.1	.1	3	1.9	4.6	1	3.8	66.7	1	.2	.4
Agricultural pesticides	–	–	–	–	–	–	–	–	–	–	–	–
Glue and gelatin	–	–	–	1	.5	.8	–	–	–	1	.1	.2
Explosives	–	–	–	1	.2	.5	–	–	–	2	*	.1
Carbon black	–	–	–	2	.2	.3	–	–	–	–	–	–
Petroleum and coal products	3	.8	1.0	4	1.5	2.7	10	.3	.3	2	1.8	5.3
Petroleum refining	2	1.3	1.7	3	1.6	2.9	10	.3	.3	2	1.8	5.3
Lubricating oils/greases	1	.1	.1	1	.3	.6	–	–	–	–	–	–
Rubber and plastics products	1	.3	1.2	4	*	.2	2	.1	.2	10	*	*
Tires/tubes	–	–	–	–	–	–	–	–	–	7	*	*
Rubber products	1	.3	1.2	1	*	*	2	*	.1	3	.1	.2
Plastics products	–	–	–	3	.1	.1	–	–	–	–	–	–
Primary metal industries	–	–	–	5	.3	.4	16	.3	.6	29	.3	.5
Blast furnaces/steel	–	–	–	–	–	–	3	.7	1.7	7	.6	1.5
Steel pipe/tube	–	–	–	–	–	–	2	.3	.9	–	–	–
Gray iron foundries	–	–	–	1	.7	2.8	2	.1	.1	6	.1	.2
Primary copper	–	–	–	–	–	–	2	.4	.9	1	.4	.7
Primary aluminum	–	–	–	2	.3	.4	2	.3	.4	10	.1	.2
Copper rolling/drawing	–	–	–	2	.1	.1	3	.1	.2	2	.1	.1
Aluminum rolling/drawing	–	–	–	–	–	–	2	.6	20.0	3	.1	.3
Total	16	1.3%	1.6%	100	.7%	1.0%	106	.6%	.8%	126	.5%	.8%

*Less than .05%

XX: Annual Operating Expenditures, by Number of Employees Engaged in Abatement Activities, by Industry, 1969

Industry	Abatement Employees No.	Operating Expenditures ($000)	Expenditure per Employee
Food and kindred products	123	$ 1,432	$11,642
Meat slaughtering	40	379	9,475
Poultry dressing	4	60	15,000
Cheeses	1	10	10,000
Fluid milk	4	17	4,250
Seafoods	–	–	–
Canned fruits/vegetables	11	157	14,273
Fish	1	7	7,000
Frozen fruits/vegetables	35	426	12,171
Wet corn milling	24	355	14,792
Raw cane sugar	3	21	7,000
Cane sugar refining	–	–	–
Malt liquors	–	–	–
Distilled liquor	–	–	–
Textile mill products	42	1,282	30,524
Cotton weaving	27	1,094	40,519
Synthetics weaving	7	124	17,714
Weaving, finishing, wool	3	15	5,000
Cotton finishing	5	49	9,800
Synthetic finishing	–	–	–
Paper and allied products	390	9,014	23,112
Pulp mills	64	1,273	19,891
Paper mills	182	5,053	27,763
Paperboard mills	89	2,031	22,820
Paper products	53	609	11,491
Building paper/board mills	2	48	24,000
Chemicals and allied products	986	32,993	33,431
Alkalies/chlorine	36	1,061	29,033
Coal tar products	10	282	28,200
Organic chemicals	358	8,916	24,891
Inorganic chemicals	164	8,012	48,854
Plastics/resins	98	4,551	46,439
Synthetic rubber	53	2,164	40,830
Cellulosic man-made fibers	63	1,353	21,476
Organic fibers, noncellulose	38	856	22,526
Pharmaceuticals	34	1,012	29,764
Detergents	26	899	35,255
Gum and wood chemicals	2	37	18,500
Fertilizers	69	2,635	38,188
Agricultural pesticides	4	165	41,250
Glue and gelatin	9	277	30,778
Explosives	19	741	39,000
Carbon black	4	42	10,500
Petroleum and coal products	237	4,756	20,068
Petroleum refining	236	4,746	20,110
Lubricating oils/greases	1	10	10,000
Rubber and plastics products	22	191	8,682
Tires/tubes	6	36	6,000
Rubber products	8	78	9,750
Plastics products	8	77	9,625
Primary metal industries	219	5,274	24,137
Blast furnaces/steel	83	3,254	39,205
Steel pipe/tube	16	232	14,500
Gray iron foundries	31	308	9,778
Primary copper	9	162	18,000
Primary aluminum	53	912	17,538
Copper rolling/drawing	10	113	10,762
Aluminum rolling/drawing	16	293	17,758
Total	2,018	$54,942	$27,226

XXI: Annual Operating Expenditures per Volume of Wastewater Discharged Annually, by Size of Plant, by Industry, 1969

Industry	20-99		100-499		500-999		1000+	
	No. of Plants	Expenditures	No. of Plants	Expenditures	No. of Plants	Expenditures	No. of Plants	Expenditures
Food and kindred products	–	–	5	$ 59	3	$ 53	5	$ 15
Textile mill products	–	–	2	187	9	39	8	40
Paper and allied products	1	$ 63	20	42	15	27	21	32
Chemicals and allied products	2	512	31	402	29	186	54	150
Petroleum products	3	93	8	30	12	99	9	28
Rubber and plastics products	1	159	3	64	3	424	6	62
Primary metal industries	–	–	4	290	10	131	24	42
Total	7	$ 97	73	$ 71	81	$ 86	127	$ 68

APPENDIX D
Public Sewer Use Data

XXII. Public Sewer Use, by Size of Plant, by Industry, 1969

XXIII. Type of Payment for Use of Public Sewer System, by Industry, 1969

XXIV. Contributions to Financing of Public Sewer Systems, by Industry, 1969

XXV. Annual Payment for Public Sewer Service, by Volume of Untreated Wastewater Discharged Thereto, by Size of Plant, by Industry, 1969

XXVI. Annual Property Tax Payment for Public Sewer Service, by Volume of Wastewater, by Size of Plant, by Industry, 1969

XXII: Public Sewer Use, by Size of Plant, by Industry, 1969

Industry	Number of Plants Employing			
	20-99	100-499	500-999	1000+
Food and kindred products	7	31	27	16
Meat slaughtering	–	7	4	7
Poultry dressing	–	3	1	–
Cheeses	2	–	1	–
Fluid milk	1	13	2	1
Seafoods	–	–	–	1
Canned fruits/vegetables	1	3	6	–
Fish	–	–	1	–
Frozen fruits/vegetables	–	2	–	2
Wet corn milling	–	2	3	1
Raw cane sugar	–	–	–	–
Cane sugar refining	2	–	4	1
Malt liquors	–	1	4	3
Distilled liquor	1	–	1	–
Textile mill products	–	12	27	12
Cotton weaving	–	7	14	9
Synthetics weaving	–	2	10	–
Weaving, finishing, wool	–	–	1	3
Cotton finishing	–	1	2	–
Synthetic finishing	–	2	–	–
Paper and allied products	2	18	11	20
Pulp mills	–	1	2	2
Paper mills	1	11	7	13
Paperboard mills	–	3	–	2
Paper products	–	2	2	2
Building paper/board mills	1	1	–	1
Chemicals and allied products	12	35	27	31
Alkalies/chlorine	1	2	–	2
Coal tar products	–	3	–	1
Organic chemicals	–	6	3	4
Inorganic chemicals	1	4	1	1
Plastics/resins	2	6	4	2
Synthetic rubber	–	1	2	–
Cellulosic man-made fibers	1	1	–	5
Organic fibers, noncellulose	–	–	1	1
Pharmaceuticals	–	3	6	5
Detergents	1	7	9	5
Gum and wood chemicals	–	1	–	1
Fertilizers	1	1	–	–
Agricultural pesticides	3	–	–	–
Glue and gelatin	2	–	–	2
Explosives	–	–	1	2
Carbon black	–	–	–	–
Petroleum and coal products	2	5	5	4
Petroleum refining	–	5	5	4
Lubricating oils/greases	2	–	–	–
Rubber and plastics products	3	11	11	22
Tires/tubes	2	1	2	12
Rubber products	1	2	5	8
Plastics products	–	8	4	2
Primary metal industries	4	11	20	32
Blast furnaces/steel	1	–	5	10
Steel pipe/tube	–	3	4	1
Gray iron foundries	1	3	3	11
Primary copper	–	–	1	–
Primary aluminum	–	–	2	3
Copper rolling/drawing	1	3	4	4
Aluminum rolling/drawing	1	2	1	3
Total	30	123	128	137

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XXIII: Type of Payment for Use of Public Sewer System, by Industry, 1969

Industry	Water Use Number	Waste Strength Number	Over-strength Charge Number	Other Number
Food and kindred products	41	7	3	12
Meat slaughtering	9	2	1	4
Poultry dressing	3	–	–	–
Cheeses	2	1	–	–
Fluid milk	12	–	–	1
Seafoods	–	–	–	–
Canned fruits/vegetables	4	–	1	2
Fish	1	–	–	–
Frozen fruits/vegetables	2	1	1	2
Wet corn milling	2	3	–	–
Raw cane sugar	–	–	–	–
Cane sugar refining	2	–	–	2
Malt liquors	3	–	–	1
Distilled liquor	1	–	–	–
Textile mill products	31	10	1	7
Cotton weaving	15	3	1	6
Synthetics weaving	10	5	–	1
Weaving, finishing, wool	3	1	–	–
Cotton finishing	2	–	–	–
Synthetic finishing	1	1	–	–
Paper and allied products	19	1	–	8
Pulp mills	2	–	–	1
Paper mills	10	–	–	5
Paperboard mills	3	1	–	1
Paper products	3	–	–	1
Building paper/board mills	1	–	–	–
Chemicals and allied products	45	5	6	15
Alkalies/chlorine	3	–	–	1
Coal tar products	1	–	1	–
Organic chemicals	3	–	1	2
Inorganic chemicals	2	–	–	–
Plastics/resins	5	–	–	4
Synthetic rubber	2	–	–	–
Cellulosic man-made fibers	3	–	–	1
Organic fibers, noncellulose	1	–	–	1
Pharmaceuticals	7	1	–	3
Detergents	10	3	4	3
Gum and wood chemicals	1	–	–	–
Fertilizers	2	–	–	–
Agricultural pesticides	3	–	–	–
Glue and gelatin	1	1	–	–
Explosives	1	–	–	–
Carbon black	–	–	–	–
Petroleum and coal products	4	–	–	3
Petroleum refining	3	–	–	2
Lubricating oils/greases	1	–	–	1
Rubber and plastics products	28	–	–	3
Tires/tubes	7	–	–	2
Rubber products	11	–	–	1
Plastics products	10	–	–	–
Primary metal industries	28	1	–	11
Blast furnaces/steel	5	1	–	2
Steel pipe/tube	3	–	–	2
Gray iron foundries	8	–	–	4
Primary copper	–	–	–	–
Primary aluminum	3	–	–	–
Copper rolling/drawing	7	–	–	–
Aluminum rolling/drawing	2	–	–	3
Total	196	24	10	59

XXIV: Contribution to Financing of Public Sewer Systems, by Industry, 1969

Industry	Number Paying Taxes	Amount Paid in Property Taxes ($000)	Number Paying Contributions	Amount Paid in Capital Contributions ($000)
Food and Kindred Products	17	$439	6	$216
Meat slaughtering	5	235	–	–
Poultry dressing	3	14	–	–
Cheeses	–	–	–	–
Fluid milk	1	6	2	33
Seafoods	–	–	–	–
Canned fruits/vegetables	1	4	1	1
Fish	1	14	–	–
Frozen fruits/vegetables	1	3	1	32
Wet corn milling	–	–	1	55
Raw cane sugar	–	–	–	–
Cane sugar refining	1	2	–	–
Malt liquors	4	161	1	95
Distilled liquor	–	–	–	–
Textile Mill Products	6	178	6	1,390
Cotton weaving	4	158	6	1,390
Synthetics weaving	1	10	–	–
Weaving, finishing, wool	–	–	–	–
Cotton finishing	1	10	–	–
Synthetic finishing	–	–	–	–
Paper and Allied Products	12	2,687	3	881
Pulp mills	–	–	–	–
Paper mills	8	2,666	2	875
Paperboard mills	1	3	1	6
Paper products	1	14	–	–
Building paper/board mills	2	4	–	–
Chemicals and Allied Products	29	891	4	2,775
Alkalies/chlorine	2	19	–	–
Coal tar products	–	–	–	–
Organic chemicals	2	63	2	1,796
Inorganic chemicals	2	25	–	–
Plastics/resins	2	56	1	978
Synthetic rubber	2	16	–	–
Cellulosic man-made fibers	1	3	–	–
Organic fibers, noncellulose	–	–	–	–
Pharmaceuticals	1	1	–	–
Detergents	10	419	1	1
Gum and wood chemicals	1	111	–	–
Fertilizers	1	93	–	–
Agricultural pesticides	1	3	–	–
Glue and gelatin	2	68	–	–
Explosives	2	14	–	–
Carbon black	–	–	–	–
Petroleum and Coal Products	6	366	2	26
Petroleum refining	6	366	2	26
Lubricating oils/greases	–	–	–	–
Rubber and Plastics Products	8	59	–	–
Tires/tubes	3	49	–	–
Rubber products	3	5	–	–
Plastics products	2	5	–	–
Primary Metal Industries	18	873	2	163
Blast furnaces/steel	6	89	–	–
Steel pipe/tube	2	430	–	–
Grey iron foundries	2	2	–	–
Primary copper	–	–	1	12
Primary aluminum	4	225	–	–
Copper rolling/drawing	2	125	–	–
Aluminum rolling/drawing	2	2	1	151
Total	96	5,493	23	5,451

XXV: Annual Payment for Public Sewer Service by Volume of Untreated Wastewater Discharged Thereto, by Size of Plant, 1969

Industry	20-99		100-499		500-999		1000+	
	No. of Plants	Expenditures	No. of Plants	Expenditures	No. of Plants	Expenditures	No. of Plants	Expenditures
Food and kindred products	4	$ 70	17	$ 165	15	$140	7	$ 38
Textile mill products	–	–	5	103	14	82	7	53
Paper and allied products	1	4	5	398	5	28	8	55
Chemicals and allied products	5	1,704	19	52	16	269	18	181
Petroleum products	1	2,380	1	2,021	2	49	1	152
Rubber and plastics products	2	88	6	73	5	126	12	97
Primary metal industries	1	48	5	150	10	81	17	231
Total	14	$ 116	58	$ 93	67	$ 90	70	$ 90

XXVI: Annual Property Tax Payment for Public Sewer Service, by Volume of Wastewater, by Size of Plant, 1969

Industry	20-99		100-499		500-999		1000+	
	No. of Plants	Expenditures	No. of Plants	Expenditures	No. of Plants	Expenditures	No. of Plants	Expenditures
Food and kindred products	–	–	4	$92	6	$ 39	4	$ 58
Textile mill products	–	–	2	44	–	–	1	138
Paper and allied products	–	–	1	27	1	4	4	6,663
Chemicals and allied products	2	$40	7	23	7	343	8	285
Petroleum products	–	–	1	99	1	126	–	–
Rubber and plastics products	–	–	–	–	2	262	3	279
Primary metal industries	–	–	4	81	3	92	6	200
Total	2	$40	19	$77	20	$132	26	$ 327

APPENDIX E
Data on Wastewater Volume and Effluents

XXVII. Total Wastewater Discharged Directly from Manufacturing Process, by Industry, 1969

XXVIII. BOD Content in Wastewater Discharged Directly from Manufacturing Process and Sanitary System, by Industry, 1969

XXIX. COD Content in Wastewater Discharged Directly from Manufacturing Process and Sanitary System, by Industry, 1969

XXX. Suspended Solids Content in Wastewater Discharged Directly from Manufacturing Process and Sanitary System, by Industry, 1969

XXXI. Other Contents in Wastewater Discharged Directly from Manufacturing Process and Sanitary System, by Industry, 1969

XXXII. BOD Content per Volume of Untreated Wastewater Discharged Directly from Manufacturing Process, by Industry, 1969

XXXIII. COD Content per Volume of Untreated Wastewater Discharged Directly from Manufacturing Process, by Industry, 1969

XXXIV. Suspended Solids per Volume of Untreated Wastewater Discharged Directly from Manufacturing Process, by Industry, 1969

XXXV. BOD Content in Discharged Wastewater per Production Employee, 1969

XXXVI. COD Content in Discharged Wastewater per Production Employee, 1969

XXXVII. Suspended Solids in Discharged Wastewater per Production Employee, 1969

XXVII. Total Wastewater Discharged Directly from Manufacturing Process, by Industry, 1968

Industry	Manufacturing Process Losses		Manufacturing Process Increases	
	Number of Plants Reporting	Gallons (000's)	Number of Plants Reporting	Gallons (000's)
Food and kindred products				
Meat slaughtering				
Poultry dressing				
Cheese				
Fluid milk				
Seafoods				
Canned fruits/vegetables				
Fish				
Frozen fruits/vegetables				
Wet corn milling				
Raw cane sugar				
Cane sugar refining				
Beet liquors				
Distilled liquor				
Textile mill products				
Cotton weaving				
Synthetics weaving				
Weaving, finishing, wool				
Cotton finishing				
Synthetic finishing				
Paper and allied products				
Pulp mills				
Paper mills				
Paperboard mills				
Paper products				
Building paper/board mills				
Chemicals and allied products				
Alkalies/chlorine				
Coal tar products				
Organic chemicals				
Inorganic chemicals				
Plastics/resins				
Synthetic rubber				
Cellulosic man-made fibers				
Organic fibers, noncellulosic				
Pharmaceuticals				
Detergents				
Gum and wood chemicals				
Fertilizers				
Agricultural chemicals				
Glue and gelatin				
Explosives				
Carbon black				
Petroleum and coal products				
Petroleum refining				
Lubricating oils/greases				
Rubber and plastics products				
Tires/tubes				
Rubber products				
Plastics products				
Primary metal industries				
Blast furnaces/steel				
Steel pipe/tube				
Gray iron foundries				
Primary copper				
Primary aluminum				
Copper rolling/drawing				
Aluminum rolling/drawing				
Total				

XXVIII: BOD Content in Wastewater Discharged Directly from Manufacturing Process and Sanitary System, by Industry, 1969

Industry	Manufacturing Process		Sanitary	
	Number of Plants Reporting	Sum (pounds)	Number of Plants Reporting	Sum (pounds)
Food and Kindred Products	48	326,989	15	3,765
Meat slaughtering	9	20,674	1	2
Poultry dressing	–		–	
Cheeses	–		–	
Fluid milk	4	9,540	4	550
Seafoods	–		–	
Canned fruits/vegetables	10	104,952	4	325
Fish	1	1,136	–	
Frozen fruits/vegetables	5	67,317	2	1,340
Wet corn milling	6	69,113	2	1,250
Raw cane sugar	1	27,804	–	
Cane sugar refining	7	25,525	1	50
Malt liquors	1	450	1	250
Distilled liquor	4	478	–	
Textile Mill Products	48	268,175	20	4,231
Cotton weaving	23	179,637	14	4,101
Synthetics weaving	8	11,723	4	90
Weaving, finishing, wool	7	19,995	1	5
Cotton finishing	6	41,730	–	
Synthetic finishing	4	15,090	1	35
Paper and Allied Products	90	2,557,295	9	2,203
Pulp mills	14	834,487	1	900
Paper mills	47	1,406,895	4	1,103
Paperboard mills	18	178,631	4	200
Paper products	7	129,300	–	
Building paper/board mills	4	7,982	–	
Chemicals and Allied Products	111	1,175,250	46	6,964
Alkalies/chlorine	5	7,697	2	9
Coal tar products	4	11,560	1	332
Organic chemicals	27	464,139	9	1,327
Inorganic chemicals	10	53,855	5	322
Plastics/resins	14	53,595	12	3,839
Synthetic rubber	5	273,300	2	99
Cellulosic man-made fibers	12	43,233	3	230
Organic fibers, noncellulose	8	140,135	3	131
Pharmaceuticals	7	4,449	2	455
Detergents	6	28,161	1	100
Gum and wood chemicals	3	5,812	–	
Fertilizers	2	3,612	–	
Agricultural pesticides	2	2,661	–	
Glue and gelatin	–		–	
Explosives	4	83,015	4	106
Carbon black	2	26	2	13
Petroleum and Coal Products	38	375,773	4	26,054
Petroleum refining	37	375,673	4	26,054
Lubricating oils/greases	1	100	–	
Rubber and Plastics Products	9	2,732	10	1,699
Tires/tubes	3	434	7	973
Rubber products	3	758	2	506
Plastics products	3	1,540	1	220
Primary Metal Industries	19	17,410	16	3,438
Blast furnaces/steel	3	13,576	2	217
Steel pipe/tube	1	164	1	7
Gray iron foundries	5	1,917	–	
Primary copper	–		–	
Primary aluminum	4	554	7	3,175
Copper rolling/drawing	1	1,000	–	
Aluminum rolling/drawing	5	198	6	39
Total	363	4,723,625	120	48,356

XXIX: COD Content in Wastewater Discharged Directly from Manufacturing Process and Sanitary System, by Industry, 1969

Industry	Manufacturing Process		Sanitary	
	Number of Plants Reporting	Sum (pounds)	Number of Plants Reporting	Sum (pounds)
Food and Kindred Products	24	361,662	7	4,001
Meat slaughtering	5	12,897	1	4
Poultry dressing	–	–	–	–
Cheeses	–	–	–	–
Fluid milk	3	3,060	2	100
Seafoods	–	–	–	–
Canned fruits/vegetables	5	228,184	1	47
Fish	–	–	–	–
Frozen fruits/vegetables	4	65,686	1	840
Wet corn milling	3	41,502	1	3,000
Raw cane sugar	–	–	–	–
Cane sugar refining	2	9,501	1	10
Malt liquors	–	–	–	–
Distilled liquor	2	832	–	–
Textile Mill Products	19	216,378	4	16,926
Cotton weaving	9	179,844	4	16,926
Synthetics weaving	2	5,000	–	–
Weaving, finishing, wool	5	24,442	–	–
Cotton finishing	2	4,492	–	–
Synthetic finishing	1	2,600	–	–
Paper and Allied Products	18	1,641,755	3	33
Pulp mills	4	413,285	–	–
Paper mills	7	895,660	1	2
Paperboard mills	3	280,290	1	24
Paper products	1	40,000	–	–
Building paper/board mills	3	12,520	1	7
Chemicals and Allied Products	94	2,353,746	24	10,656
Alkalies/chlorine	5	94,950	–	–
Coal tar products	4	60,090	1	411
Organic chemicals	25	992,175	5	1,940
Inorganic chemicals	8	280,500	2	405
Plastics/resins	12	80,741	5	6,684
Synthetic rubber	7	426,656	2	196
Cellulosic man-made fibers	8	83,423	2	400
Organic fibers, noncellulose	6	159,142	1	150
Pharmaceuticals	3	331	1	200
Detergents	3	7,662	1	200
Gum and wood chemicals	2	8,967	–	–
Fertilizers	2	4,625	–	–
Agricultural pesticides	2	7,300	–	–
Glue and gelatin	–	–	–	–
Explosives	5	147,120	2	35
Carbon black	2	64	2	35
Petroleum and Coal Products	36	1,286,845	3	204,046
Petroleum refining	35	1,286,420	3	204,046
Lubricating oils/greases	1	425	–	–
Rubber and Plastics Products	5	7,768	5	3,242
Tires/tubes	2	2,300	3	2,877
Rubber products	2	4,068	1	145
Plastics products	1	1,400	1	220
Primary Metal Industries	11	44,117	2	93
Blast furnaces/steel	2	5,870	–	–
Steel pipe/tube	–	–	–	–
Gray iron foundries	3	7,135	–	–
Primary copper	1	1,335	–	–
Primary aluminum	2	23,558	1	49
Copper rolling/drawing	2	5,8755	–	–
Aluminum rolling/drawing	1	344	1	44
Total	207	5,912,272	48	238,997

XXX: Suspended Solids Content in Wastewater Discharged Directly from Manufacturing Process and Sanitary System, by Industry, 1969

Industry	Manufacturing Process		Sanitary	
	Number of Plants Reporting	Sum (pounds)	Number of Plants Reporting	Sum (pounds)
Food and Kindred Products	44	966,370	9	3,398
Meat slaughtering	8	5,579	1	2
Poultry dressing	–	–	–	–
Cheeses	–	–	–	–
Fluid milk	3	6,680	3	550
Seafoods	–	–	–	–
Canned fruits/vegetables	9	8,550	1	16
Fish	1	316	–	–
Frozen fruits/vegetables	4	40,183	–	–
Wet corn milling	5	48,146	2	2,530
Raw cane sugar	1	787,143	–	–
Cane sugar refining	8	68,960	1	100
Malt liquors	1	300	1	200
Distilled liquor	4	513	–	–
Textile Mill Products	26	42,555	10	11,837
Cotton weaving	11	31,932	8	11,747
Synthetics weaving	3	2,176	1	50
Weaving, finishing, wool	7	4,737	–	–
Cotton finishing	3	2,526	–	–
Synthetic finishing	2	1,184	1	40
Paper and Allied Products	87	2,079,155	6	1,424
Pulp mills	14	295,344	1	900
Paper mills	46	1,575,473	3	504
Paperboard mills	17	114,021	1	16
Paper products	7	91,040	–	–
Building paper/board mills	3	3,277	1	4
Chemicals and Allied Products	110	1,317,684	27	7,043
Alkalies/chlorine	6	263,700	–	–
Coal tar products	3	3,675	1	42
Organic chemicals	29	463,852	5	1,720
Inorganic chemicals	9	340,436	2	51
Plastics/resins	13	18,892	7	2,434
Synthetic rubber	6	82,160	2	23
Cellulosic man-made fibers	10	48,806	2	70
Organic fibers, noncellulose	6	22,419	–	–
Pharmaceuticals	4	8,220	1	2,337
Detergents	6	13,634	1	83
Gum and wood chemicals	1	425	–	–
Fertilizers	4	14,775	–	–
Agricultural pesticides	3	938	–	–
Glue and gelatin	–	–	–	–
Explosives	6	34,609	4	33
Carbon black	4	1,143	2	250
Petroleum and Coal Products	35	207,244	3	34,077
Petroleum refining	34	207,108	3	34,077
Lubricating oils/greases	1	136	–	–
Rubber and Plastics Products	14	8,998	10	2,929
Tires/tubes	6	5,681	5	1,885
Rubber products	3	886	3	423
Plastics products	5	2,431	2	620
Primary Metal Industries	45	578,819	16	5,388
Blast furnaces/steel	11	186,133	4	1,550
Steel pipe/tube	3	3,579	1	5
Gray iron foundries	7	9,946	–	–
Primary copper	1	10,680	–	–
Primary aluminum	9	356,388	4	3,017
Copper rolling/drawing	7	4,121	2	673
Aluminum rolling/drawing	7	7,971	5	143
Total	361	5,200,826	81	66,097

XXXI: Other Contents in Wastewater Discharged Directly from Manufacturing Process and Sanitary System, by Industry, 1969

Industry	Manufacturing Process		Sanitary	
	Number of Plants Reporting	Sum (pounds)	Number of Plants Reporting	Sum (pounds)
Food and Kindred Products	2	20,325	–	–
Meat slaughtering	1	325	–	–
Poultry dressing	–	–	–	–
Cheeses	–	–	–	–
Fluid milk	–	–	–	–
Seafoods	–	–	–	–
Canned fruits/vegetables	–	–	–	–
Fish	–	–	–	–
Frozen fruits/vegetables	–	–	–	–
Wet corn milling	–	–	–	–
Raw cane sugar	–	–	–	–
Cane sugar refining	1	20,000	–	–
Malt liquors	–	–	–	–
Distilled liquor	–	–	–	–
Textile Mill Products	–	–	–	–
Cotton weaving	–	–	–	–
Synthetics weaving	–	–	–	–
Weaving, finishing, wool	–	–	–	–
Cotton finishing	–	–	–	–
Synthetic finishing	–	–	–	–
Paper and Allied Products	1	118,800	–	–
Pulp mills	–	–	–	–
Paper mills	–	–	–	–
Paperboard mills	–	–	–	–
Paper products	1	118,800	–	–
Building paper/board mills	–	–	–	–
Chemicals and Allied Products	19	533,492	1	15
Alkalies/chlorine	1	18,654	–	–
Coal tar products	–	–	–	–
Organic chemicals	6	362,671	–	–
Inorganic chemicals	2	38,129	–	–
Plastics/resins	2	5,627	–	–
Synthetic rubber	–	–	–	–
Cellulosic man-made fibers	1	600	–	–
Organic fibers, noncellulose	–	–	–	–
Pharmaceuticals	1	34	–	–
Detergents	1	415	–	–
Gum and wood chemicals	–	–	–	–
Fertilizers	3	10,362	–	–
Agricultural pesticides	–	–	–	–
Glue and gelatin	–	–	–	–
Explosives	2	97,000	1	15
Carbon black	–	–	–	–
Petroleum and Coal Products	8	36,508	–	–
Petroleum refining	8	36,508	–	–
Lubricating oils/greases	–	–	–	–
Rubber and Plastics Products	3	1,005	–	–
Tires/tubes	1	25	–	–
Rubber products	1	20	–	–
Plastics products	1	960	–	–
Primary Metal Industries	9	37,740	2	38
Blast furnaces/steel	2	14,441	–	–
Steel pipe/tube	–	–	–	–
Gray iron foundries	1	70	–	–
Primary copper	–	–	–	–
Primary aluminum	5	20,729	2	38
Copper rolling/drawing	1	2,500	–	–
Aluminum rolling/drawing	–	–	–	–
Total	42	747,870	3	53

XXXII: BID Content per Volume of Untreated Wastewater Discharged from Manufacturing Process, by Industry, 1969

Industry	Number of Plants Reporting	Wastewater Discharged (MGD)	BOD (pounds)	BOD per MGD of Wastewater (pounds)
Food and Kindred Products	12	146.9	106,272	723
Meat slaughtering	1	.1	7,500	75,000
Poultry dressing	–	–	–	–
Cheeses	–	–	–	–
Fluid milk	–	–	–	–
Seafoods	–	–	–	–
Canned fruits/vegetables	1	.1	415	4,150
Fish	–	–	–	–
Frozen fruits/vegetables	1	1.0	20,028	20,028
Wet corn milling	1	1.5	25,000	16,666
Raw cane sugar	1	7.0	27,804	3,972
Cane sugar refining	7	137.2	25,525	186
Malt liquors	–	–	–	–
Distilled liquor	–	–	–	–
Textile Mill Products	14	33.0	83,822	2,537
Cotton weaving	8	22.9	40,923	1,783
Synthetics weaving	1	1.6	3,500	2,229
Weaving, finishing, wool	1	.3	1,740	5,437
Cotton finishing	4	8.2	37,659	4,592
Synthetic finishing	–	–	–	–
Paper and Allied Products	36	437.2	1,336,878	3,057
Pulp mills	5	135.4	532,902	3,934
Paper mills	20	247.2	676,825	2,738
Paperboard mills	6	16.6	47,409	2,847
Paper products	4	37.5	77,000	2,053
Building paper/board mills	1	.4	2,742	6,200
Chemicals and Allied Products	58	564.7	613,402	1,086
Alkalies/chlorine	5	31.3	7,697	245
Coal tar products	1	.2	1,760	10,352
Organic chemicals	13	108.6	330,513	3,044
Inorganic chemicals	6	189.3	32,555	172
Plastics/resins	8	46.1	42,165	914
Synthetic rubber	3	58.8	113,000	1,922
Cellulosic man-made fibers	5	37.3	17,342	465
Organic fibers, noncellulose	4	7.3	12,985	1,783
Pharmaceuticals	–	–	–	–
Detergents	5	10.3	10,622	1,033
Gum and wood chemicals	2	.1	5,632	46,933
Fertilizers	2	1.9	3,612	1,931
Agricultural pesticides	1	.3	2,504	8,346
Glue and gelatin	–	–	–	–
Explosives	3	73.3	33,015	450
Carbon black	–	–	–	–
Petroleum and Coal Products	2	5.7	2,450	432
Petroleum refining	2	5.7	2,450	432
Lubricating oils/greases	–	–	–	–
Rubber and Plastics Products	6	9.4	1,381	146
Tires/tubes	2	5.0	384	77
Rubber products	2	.7	157	210
Plastics products	2	3.7	840	227
Primary Metal Industries	12	109.9	16,197	147
Blast furnaces/steel	2	42.0	12,676	301
Steel pipe/tube	1	–	164	6,323
Gray iron foundries	2	26.4	1,683	63
Primary copper	–	–	–	–
Primary aluminum	2	20.4	482	23
Copper rolling/drawing	1	–	1,000	20,000
Aluminum rolling/drawing	4	21.0	192	9
Total	140	1,306.8	2,160,402	1,653

XXXIII COD Content per Volume of Untreated Wastewater Discharged Directly from Manufacturing Process, by Industry, 1969

Industry	Number of Plants Reporting	Wastewater Discharged (MGD)	COD (pounds)	COD per MGD of Wastewater (pounds)
Food and Kindred Products	4	35.5	33,989	956
Meat slaughtering	1	.1	7,800	78,000
Poultry dressing	–	–	–	–
Cheeses	–	–	–	–
Fluid milk	–	–	–	–
Seafoods	–	–	–	–
Canned fruits/vegetables	–	–	–	–
Fish	–	–	–	–
Frozen fruits/vegetables	1	1.0	16,688	16,688
Wet corn milling	–	–	–	–
Raw cane sugar	–	–	–	–
Cane sugar refining	2	34.4	9,501	275
Malt liquors	–	–	–	–
Distilled liquor	–	–	–	–
Textile Mill Products	5	22.9	62,669	2,733
Cotton weaving	4	22.4	58,547	2,610
Synthetics weaving	–	–	–	–
Weaving, finishing, wool	–	–	–	–
Cotton finishing	1	.5	4,122	8,244
Synthetic finishing	–	–	–	–
Paper and Allied Products	4	3.4	102,477	29,770
Pulp mills	–	–	–	–
Paper mills	2	2.0	13,500	6,750
Paperboard mills	1	1.0	80,000	80,000
Paper products	–	–	–	–
Building paper/board mills	1	.4	8,977	20,300
Chemicals and Allied Products	50	478.0	1,509,087	3,157
Alkalies/chlorine	5	25.6	94,950	3,701
Coal tar products	1	.2	3,340	19,647
Organic chemicals	12	62.1	666,647	10,735
Inorganic chemicals	4	181.3	228,000	1,257
Plastics/resins	7	26.1	67,006	2,565
Synthetic rubber	3	58.8	325,600	5,540
Cellulosic man-made fibers	4	33.6	29,880	889
Organic fibers, noncellulose	3	6.8	20,150	2,971
Pharmaceuticals	–	–	–	–
Detergents	3	8.0	7,662	960
Gum and wood chemicals	2	.1	8,967	74,725
Fertilizers	2	1.9	4,625	2,473
Agricultural pesticides	1	.3	7,010	23,366
Glue and gelatin	–	–	–	–
Explosives	3	73.3	45,250	617
Carbon black	–	–	–	–
Petroleum and Coal Products	2	5.7	9,935	1,755
Petroleum refining	2	5.7	9,935	1,755
Lubricating oils/greases	–	–	–	–
Rubber and Plastics Products	2	4.7	2,265	480
Tires/tubes	1	4.5	2,410	475
Rubber products	1	.2	125	578
Plastics products	–	–	–	–
Primary Metal Industries	9	64.8	43,544	671
Blast furnaces/steel	2	2.6	5,870	2,215
Steel pipe/tube	–	–	–	–
Gray iron foundries	2	26.4	7,120	269
Primary copper	1	19.5	1,335	68
Primary aluminum	1	11.8	23,000	1,949
Copper rolling/drawing	2	4.0	5,875	1,450
Aluminum rolling/drawing	1	.4	344	945
Total	76	615.1	1,763,966	2,867

XXXIV: Suspended Solids per Volume of Untreated Wastewater Discharged Directly from Manufacturing Process, by Industry, 1969

Industry	Number of Plants Reporting	Wastewater Discharged (MGD)	Suspended Solids (pounds)	Suspended Solids per MGD of Wastewater (pounds)
Food and Kindred Products	12	146.9	862,152	5,869
Meat slaughtering	1	.1	25	250
Poultry dressing	–	–	–	–
Cheeses	–	–	–	–
Fluid milk	–	–	–	–
Seafoods	–	–	–	–
Canned fruits/vegetables	1	.1	20	200
Fish	–	–	–	–
Frozen fruits/vegetables	1	1.0	3,004	3,004
Wet corn milling	1	1.5	6,000	4,000
Raw cane sugar	1	7.0	787,143	112,449
Cane sugar refining	7	137.2	65,960	480
Malt liquors	–	–	–	–
Distilled liquor	–	–	–	–
Textile Mill Products	8	26.0	15,141	583
Cotton weaving	5	22.4	12,087	538
Synthetics weaving	-	–	–	–
Weaving, finishing, wool	1	.3	780	2,437
Cotton finishing	2	3.2	2,274	710
Synthetic finishing	–	–	–	–
Paper and Allied Products	36	437.2	1,416,930	3,240
Pulp mills	5	135.4	159,831	1,180
Paper mills	20	247.2	1,099,580	4,448
Paperboard mills	6	16.6	75,942	4,561
Paper products	4	37.5	81,000	2,160
Building paper/board mills	1	.4	577	1,304
Chemicals and Allied Products				
Alkalies/chlorine	5	30.5	243,700	7,977
Coal tar products	–	–	–	–
Organic chemicals	16	91.1	403,673	4,430
Inorganic chemicals	5	195.0	335,236	1,719
Plastics/resins	7	45.6	15,320	336
Synthetic rubber	3	58.8	60,760	1,033
Cellulosic man-made fibers	4	30.1	42,740	1,420
Organic fibers, noncellulose	2	.7	175	239
Pharmaceuticals	–	–	–	–
Detergents	5	10.3	8,115	789
Gum and wood chemicals	1	.0	425	8,500
Fertilizers	3	65.4	375	5
Agricultural pesticides	1	.3	876	2,920
Glue and gelatin	–	–	–	–
Explosives	4	75.0	20,605	274
Carbon black	1	.6	1,000	1,666
Petroleum and Coal Products	2	5.7	3,602	636
Petroleum refining	2	5.7	3,602	636
Lubricating oils/greases	–	–	–	–
Rubber and Plastics Products	8	29.6	7,357	248
Tires/tubes	4	25.2	5,501	217
Rubber products	1	.5	135	254
Plastics products	3	3.8	1,721	449
Primary Metal Industries	25	249.0	539,311	2,165
Blast furnaces/steel	6	104,3	154,677	1,482
Steel pipe/tube	3	2.4	3,579	1,519
Gray iron foundries	2	26.4	3,955	149
Primary copper	1	19.5	10,680	547
Primary aluminum	7	71.3	355,559	4,988
Copper rolling/drawing	2	4.0	3,050	753
Aluminum rolling/drawing	4	21.0	7,811	371
Total	148	1,497.0	3,977,493	2,655

XXXV: BOD Content in Discharged Wastewater per Production Employee, 1969

Industry	Total Production Employees	Total BOD Content (pounds)	Pounds of BOD per Production Employee
Food and Kindred Products	31,427	481,275	15
Meat slaughtering	5,904	21,811	3
Poultry dressing	–	–	–
Cheeses	42	46	1
Fluid milk	508	10,090	19
Seafoods	–	–	–
Canned fruits/vegetables	4,336	105,315	24
Fish	844	1,136	1
Frozen fruits/vegetables	5,182	74,157	14
Wet corn milling	5,323	79,163	14
Raw cane sugar	474	27,804	58
Cane sugar refining	3,910	25,575	6
Malt liquors	3,782	135,700	35
Distilled liquor	1,122	478	0.4
Textile Mill Products	59,285	279,739	4
Cotton weaving	41,741	183,750	4
Synthetics weaving	7,857	11,813	1
Weaving, finishing, wool	5,686	20,000	3
Cotton finishing	2,090	49,051	23
Synthetic finishing	1,911	15,125	7
Paper and Allied Products	64,103	2,602,833	40
Pulp mills	7,231	835,372	115
Paper mills	40,441	1,449,048	35
Paperboard mills	9,933	181,131	18
Paper products	4,522	129,300	28
Building paper/board mills	1,976	7,982	4
Chemicals and Allied Products	117,295	1,154,508	9
Alkalies/chlorine	4,311	18,836	4
Coal tar products	6,229	10,132	1
Organic chemicals	27,502	448,216	16
Inorganic chemicals	5,024	55,476	11
Plastics/resins	20,868	55,891	2
Synthetic rubber	6,437	256,354	39
Cellulosic man-made fibers	13,954	37,751	2
Organic fibers, noncellulose	9,303	140,366	15
Pharmaceuticals	5,371	7,419	1
Detergents	5,701	30,200	5
Gum and wood chemicals	845	5,832	6
Fertilizers	73	12	0.1
Agricultural Pesticides	366	2,661	7
Glue and gelatin	–	–	–
Explosives	10,682	85,321	7
Carbon black	629	39	0.06
Petroleum and Coal Products	17,969	147,087	8
Petroleum refining	17,805	146,971	8
Lubricating oils/greases	164	116	0.7
Rubber and Plastics Products	19,901	4,199	0.2
Tires/tubes	13,696	1,858	0.1
Rubber products	3,759	1,321	0.3
Plastics products	2,446	1,020	0.4
Primary Metal Industries	44,956	21,619	0.4
Blast furnaces/steel	9,626	13,793	1
Steel pipe/tube	982	171	0.1
Gray iron foundries	12,510	2,596	0.2
Primary copper	–	–	–
Primary aluminum	13,590	3,752	0.2
Copper rolling/drawing	360	1,000	2
Aluminum rolling/drawing	7,888	305	0.03
Total	354,936	4,691,161	13

XXXVI: COD Content in Discharged Wasterwater per Production Employee, 1969

Industry	Total Production Employees	Total COD Content (pounds)	Pounds of COD Per Production Employee
Food and Kindred Products	15,024	379,263	25
Meat slaughtering	4,514	12,901	2
Poultry dressing	–	–	–
Cheeses	–	–	–
Fluid milk	483	3,160	6
Seafoods	–	–	–
Canned fruits/vegetables	2,221	228,231	102
Fish	–	–	–
Frozen fruits/vegetables	4,839	75,726	15
Wet corn milling	1,084	48,902	45
Raw cane sugar	–	–	–
Cane sugar refining	1,308s	9,511	7
Malt liquors	–	–	–
Distilled liquor	575	832	1
Textile Mill Products	32,281	233,304	7
Cotton weaving	25,331	196,770	7
Synthetics weaving	2,225	5,000	2
Weaving, finishing, wool	3,700	24,442	6
Cotton finishing	550	4,492	8
Synthetic finishing	475	2,600	5
Paper and Allied Products	11,307	1,644,338	145
Pulp mills	2,006	413,285	206
Paper mills	4,459	895,662	200
Paperboard mills	3,026	282,864	93
Paper products	390	40,000	102
Building paper/board mills	1,426	12,527	8
Chemicals and Allied Products	88,414	2,105,060	23
Alkalies/chlorine	3,106	102,321	32
Coal tar products	6,229	57,161	9
Organic chemicals	18,170	901,125	49
Inorganic chemicals	3,792	167,205	44
Plastics/resins	14,453	88,450	6
Synthetic rubber	6,832	377,957	55
Cellulosic man-made fibers	10,136	72,823	7
Organic fibers, noncellulose	8,265	159,427	19
Pharmaceuticals	1,227	535	0.4
Detergents	2,922	12,380	4
Gum and wood chemicals	713	8,997	12
Fertilizers	73	125	1
Agricultural pesticides	366	7,300	19
Glue and gelatin	–	–	–
Explosives	11,501	149,155	12
Carbon black	629	99	0.1
Petroleum and Coal Products	16,835	459,355	27
Petroleum refining	16,671	458,850	27
Lubricating oils/greases	164	505	3
Rubber and Plastics Products	14,148	11,859	0.8
Tires/tubes	10,106	5,779	0.5
Rubber products	1,942	4,460	2
Plastics products	2,100	1,620	0.7
Primary Metal Industries	20,834	45,494	2
Blast furnaces/steel	1,950	5,870	3
Steel pipe/tube	–	–	–
Gray iron foundries	7,332	8,384	1
Primary copper	6,549	1,335	0.2
Primary aluminum	2,292	23,607	10
Copper rolling/drawing	1,159	5,875	5
Aluminum rolling/drawing	1,552	423	0.2
Total	198,843	4,878,674	24

XXXVII: Suspended Solids Content in Discharged Wasterwater per Production Employee, 1969

Industry	Total Production Employees	Total SS Content (pounds)	Pounds of SS Per Production Employee
Food and Kindred Products	25,716	971,893	37
Meat slaughtering	5,426	5,581	1
Poultry dressing	–	–	–
Cheeses	–	–	–
Fluid milk	483	7,230	14
Seafoods	–	–	–
Canned fruits/vegetables	3,906	8,591	2
Fish	844	316	0.3
Frozen fruits/vegetables	4,182	40,183	9
Wet corn milling	4,978	52,776	10
Raw cane sugar	474	787,143	1,660
Cane sugar refining	3,951	69,060	17
Malt liquors	350	500	1
Distilled liquor	1,122	513	0.4
Textile Mill Products	38,921	54,372	1
Cotton weaving	28,626	43,679	1
Synthetics weaving	2,768	2,206	0.7
Weaving, finishing, wool	5,686	4,737	0.8
Cotton finishing	986	2,526	2
Synthetic finishing	855	1,224	1
Paper and Allied Products	62,818	2,224,701	35
Pulp mills	7,231	305,766	42
Paper mills	39,766	1,710,377	43
Paperboard mills	9,323	114,237	12
Paper products	4,522	91,040	20
Builidng paper/board mills	1,976	3,281	1
Chemicals and Allied Products	104,886	1,340,793	12
Alkalies/chlorine	3,903	267,708	68
Coal tar products	6,229	26,227	4
Organic chemicals	23,910	283,432	11
Inorganic chemicals	4,933	425,309	86
Plastics/resins	15,874	29,074	1
Synthetic rubber	6,832	76,985	11
Cellulosic man-made fibers	10,679	44,946	4
Organic fibers, noncellulose	6,425	22,429	3
Pharmaceuticals	4,796	12,177	2
Detergents	5,832	14,025	2
Gum and wood chemicals	689	525	0.7
Fertilizers	1,471	14,775	10
Agricultural pesticides	438	1,138	2
Glue and gelatin	–	–	–
Explosives	12,246	120,650	9
Carbon black	629	1,393	2
Petroleum and Coal Products	16,295	172,697	10
Petroleum refining	16,131	148,312	9
Lubricating oils/greases	164	24,385	148
Rubber and Plastics Products	24,859	15,560	0.6
Tires/tubes	16,860	10,899	0.6
Rubber products	4,211	2,042	0.4
Plastics products	3,788	2,618	0.6
Primary Metal Industries	85,732	604,167	7
Blast furnaces/steel	17,461	195,347	11
Steel pipe/tube	6,040	3,584	0.5
Gray iron foundries	23,278	20,712	0.8
Primary copper	6,549	10,680	1
Primary aluminum	20,309	360,356	17
Copper rolling/drawing	4,022	4,794	1
Aluminum rolling/drawing	8,073	8,693	1
Total	359,227	5,384,184	14